

*A Semimonthly Technical Newspaper*

# ***Metallurgical & Chemical Engineering***

New York, August 15, 1917

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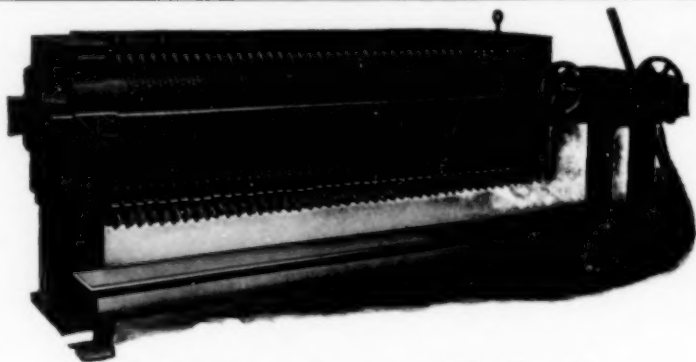
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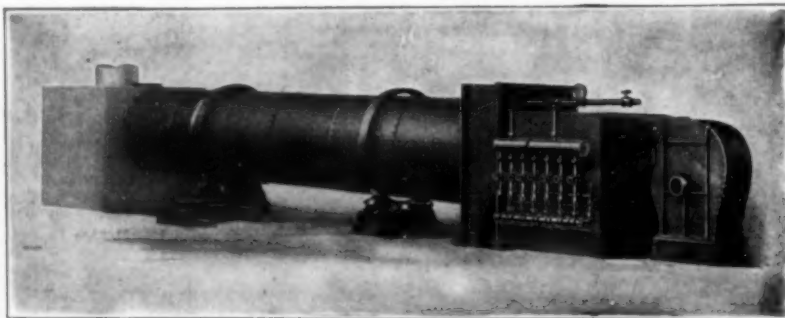
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## Profits of the Steel Corporation

Earnings of the steel companies increased through the second quarter of this year and unless production is greatly curtailed by hot weather the earnings in the present quarter will make a new high record. In presenting its report for the second quarter, the United States Steel Corporation deducted an allowance for the excess profits tax on the basis of the House bill as reported to the Senate July 3. It is correct, of course, to deduct taxes before reporting earnings, but at the same time this particular tax is upon profits. The first quarter earnings had been reported without deduction. of course, but the estimated amount for the first quarter is deducted from the surplus previously reported for the quarter. To harmonize the reports for the two quarters the figures may be presented thus:

	First quarter.	Second quarter.
Total profits .....	\$113,121,012	\$144,498,076
Excess profits tax.....	33,863,000	53,918,872

Earnings remaining . \$79,258,012      \$90,579,204

The excess profits tax thus computed is not particularly onerous, even though it represented 30 per cent of the total profits in the first quarter and in the second quarter 37 per cent. The second quarter earnings, even with the tax deducted, were at the rate of \$362,000,000 a year, whereas the earnings in 1916 were \$333,574,178, and the earnings in the best preceding year, 1907, were \$160,964,674.

Since the latter part of 1915 the tonnage output of the Steel Corporation has not varied greatly. There has been an increase on account of new plant capacity, but not as large an increase as occurred in the case of the independents. Last winter, output was materially restricted on account of traffic congestion on the railroads which persisted even to the second quarter of this year. The earnings were about \$17,000,000 per month in the last quarter of 1915, and they amounted to about \$50,000,000 last June, without allowance for the excess profits tax. By far the major part of the increase in earnings has been due to higher prices realized on the shipments. These increases followed advances in the open market by a period of from six to nine months, as the corporation has been sold well ahead. Last December, January and February the earnings were less than in the preceding November, this being due to restricted production, coupled with the fact that from May to July inclusive, the steel market had not advanced materially. Beginning with last March there have again been large increases continued in monthly earnings. The June shipments were chiefly against sales made last November, as an average period, and as the corporation's prices

continued to advance until the latter part of April further increases in earnings per ton are to be expected. The corporation did not participate in the advances made by independent mills in May and June.

The utterly fictitious character of the finished steel market as lately quoted is brought out by some simple comparisons. The June shipments were about 1,250,000 gross tons, while the total profits were \$50,000,000. There is good ground for estimating that the average invoice price of the shipments was at least \$60 a ton less than the lowest prices now quoted as "the market": 4½ cents for bars and shapes, 8 or 9 cents for sheets, 9 or 10 cents for plates, and so on. Were such prices realized the profits would be \$100 per ton instead of \$40 and a month's total profits would be \$125,000,000, equal to \$1,500,000,000 for a year. As the corporation, at present, is less than a 50 per cent interest, the steel industry's total profits would be considerably in excess of three billions a year, or about three billions greater than the average profits in the three years preceding the war. Serious question has been raised whether a much less amount than this could be raised in war taxes without greatly disturbing business. If there is question whether all the industries of the country together cannot pay two billions without having their activities impaired, it is quite certain that one class, the consumers of steel, could not possibly pay an extra three billion to the producers of steel.

No doubt the steel producers realize this fact perfectly. They have shown no disposition to point it out, and two reasons for the reticence may be assigned. First, they would like to see the business run along with consumers paying higher and higher prices until something breaks of its own accord. Second, they have been fearful of the Government exacting from them prices so low that nothing like a reasonable profit would remain. For this fear certain persons in position of more or less authority have given good ground, for repeatedly they have spoken of "cost plus 10 per cent" which is absurd in the case of steel, because in the case of an integrated concern, meaning 75 to 85 per cent of all the production, the capital is turned over, at full operation, once in from two and a half to three years, so that 10 per cent on the cost of production is from 3 to 4 per cent on the investment, with no allowance for depreciation and exhaustion allowances.

The Steel Corporation realized the danger of the situation when last April it ceased advancing its prices. Its last official prices average fully \$30 a ton lower than the prices now quoted as the market, while its realized prices in June were as much below its quotations.

A readjustment in steel prices is about to occur, whereby a level will be reached at which business can be conducted, and it will readily be observed that very great reductions from the present fictitious quotations can occur without pushing earnings of steel producers below an extremely satisfactory level. In the meantime, buying by private consumers and the allied governments has been almost entirely held up, awaiting some stability in prices before making future commitments.

### The Handwriting on the Wall

Commodity prices are up, away up beyond that warranted by the present wage scale; either the wages must go up, or the prices come down to a more equitable ratio—a disastrous explosion of domestic disorders will unquestionably follow a maintenance of the present status. It may be accepted without argument that prices, taken by and large, are too high. Even thoughtful manufacturers have been moved to restrain if possible the unconscionable antics of the soaring markets by urging caution, knowing the truth in the old song, "Never birdie flew so high she didn't have to light." And in that "lighting" is the rub—for prices have been so top heavy that a readjustment is absolutely necessary, and yet the danger of a crash is imminent. One of the most pressing problems before the American government, manufacturer and common citizen, is therefore the ways and means of getting the prices of raw materials and finished products down to reasonable levels, and that safely.

Individual effort on the part of isolated manufacturers of unusual public spirit will not affect the desired result, for his patriotic differential would be meat for the middleman, as long as other producers demanded and could get a higher price for the same material.

On the other hand, a representation from the producers meeting and agreeing upon a "fair and equitable" price would be little more successful. On the face of it, this seems to savor much of illegal combinations for fixing prices, and is very liable to all the ills of monopolistic control. A glowing example of the way this scheme would work is before our eyes from the conference of bituminous coal operators. Here a standard price of three dollars a ton at the mouth of the mine was promulgated, a price promptly denounced as exorbitant by a cabinet member, and frankly acknowledged by the coal trade to be so good as to allow them a very fattening income to make up for "lean" years in the past. Even though the scheme would work better with other more patriotic and more centralized industries, such as aluminium, the difficulties grow apace with decentralized, poorly organized producers, such as, for instance, fertilizers.

If only the Government were concerned, if it were the only buyer of a certain commodity, an "excess-profits tax" would in effect lower prices to a reasonable figure. England, for instance, through her Ministry of Munitions, controls essential industries, both as to their labor conditions and their profits, the latter being generally limited to 120 per cent of the average before the war, any excess going to the government. Should the Government be the only consumer it would be entirely indifferent what price might be charged, since all excess returns as taxes. What boots it, however, to ruin less fortunate corporations and individuals through extortionate prices for necessities, in order that a larger excess-profits tax might go into the national treasury? Even though the outsider survive, the arrangement savors much of hateful taxation without representation; furthermore the principle of "one price to all" is lost.

A further suggestion advanced by paternalists is that the Government bodily take over and operate certain basic industries. This scheme is too un-American to receive much consideration. Or rather, the American public is so familiar with the uneconomical and graft-ridden administration of certain public undertakings, that they have a suspicion that such hastily devised governmental operation would be quite likely to defeat its own ends. American industry is so delicately interrelated and depends so much upon the directing force of innumerable keen masters to run along of its own inertia after the operating minds are removed and replaced by well-meaning but less competent bureaucrats.

If one were willing to accept the hackneyed excuse of the profiteer—the overworked “law of supply and demand”—he might think that the best way to reduce prices was to reduce the demand, that is, to curtail consumption. If the entire consuming public could be reached and convinced and induced to reduce its consumption, the demand for a certain commodity, or for all commodities, for that matter, might be reduced to such a point that one cause for high prices would be eliminated. To state this possibility is but to realize its impossibility. Yet in some such manner must and will the prices of munitions to the Government be reduced. And if we mistake not, the tools are already in the hands of the Government, and the Government is proceeding to use them. It now behooves the industries to read the auguries, and direct their steps accordingly.

The twins “supply and demand” are hybrid; the terms are not of the same order. The expressions “supply and requirement” and “offering and demand” are of the same order. The former is material, the latter is mental. “Demand” is what people ask for, “offering” too often is the bluff of the producer; “supplies” are really the material on hand to sell, and “requirements” represent the real needs of the consumers. Prices can evidently be raised by a large demand and small offering as readily, or even more readily, than by a long requirement and a short supply; the danger one can not see is the worst feared. In fact the producer is now busy explaining that present prices are really fictitious in that they cover a low volume of sales forced to that level by the demand of excited consumers whose immediate requirements had not been contracted for months ago.

Yet if prices can be boosted by a commercial poker game, they certainly can be lowered by like mental processes. Witness the stagnation of business and the abrupt halt in price ascension immediately following the President's statement about “Patriotism and Profits,” and his proclamation of adherence to the “One Price to All” principle. The requirements still exist; yet the demand has vanished.

Now comes the War Industries Board and their Central Purchasing Commission with advisory power over all army and navy contracts. These committees are composed of men who know their business, who have been in touch with big business long enough to be informed of the total production of any one commodity, to remember the prices which a year or two ago were re-

turning a very fair profit to the manufacturers, and to understand the effect which altered conditions and wage advances should have upon these prices. They also have at their disposal correct information as to the exact figures the allied governments are paying for their munitions, both at home in “controlled” industries, and abroad on contracts. With this combined experience, knowledge and data, the War Industries Board will call into conference with it committees of producers of munitions—steel, alcohol, gasoline, motor trucks, copper, what you will—and say to this committee of manufacturers, “We want fifty per cent of your output of ship plates, we will pay 2½ cents a pound on account, and hold the exact price in abeyance pending investigation of the actual costs by the Federal Trade Commission.”

Then the American manufacturer can do two things. He can either accept the offer of the business, gracefully and patriotically, or he can refuse. But on second thought, can he refuse, short of shutting down his plant? For suppose he elects to refuse the Government business and attempts to renew business on the present basis of maybe 6, hopefully 10 cents per pound. Who else but the Government is buying ship plates just now, what with the activities of the Shipping Board in laying down new construction and commandeering ships on the ways? And would England wish to buy ship plates from America at maybe 6, hopefully 10 cents a pound, when she can get them at home for 2½ cents? Or where would the steel man get bottoms to ship his metal even though he find a neutral market? After surmounting these difficulties, who would lift the embargo on plates from his suffering shoulders? Or does he delude himself into thinking the independent structural steel fabricators or tank and boiler makers are coming to his rescue for any higher price than the “one price to all” assured by the President?

The consumer views the situation with equanimity. The psychological aspect is pregnant with power: the demand is sentimentally lacking; the material aspect is overbearing in its weight: the requirements are artificially limited. The price is bound to come down, and the manufacturer should steer his course accordingly, and at once, thankful that he is assured of a just price, “a price which will sustain the industries concerned in a high state of efficiency, provide a living for those who conduct them, enable them to pay good wages, and make possible expansion of their enterprises which will from time to time become necessary as the stupendous undertakings of this great war develop.” Where could he find extenuating circumstances to justify more liberal treatment from consumers, at last with the whip hand?

Of course the war industries board has advisory capacity over Government purchases only. But private enterprise can wait for a price adjustment—absolutely nothing *must* be done to-day excepting that which is necessary for the war. Then too, the illustration is taken from a certain branch of the steel industry because its control has been best accomplished at the present day. For ship plates merely substitute TNT, tungsten, pyrite, or what not.

## Readers' Views and Comments

### The Sulphuric Acid Treatment of Gasoline

To the Editor of Metallurgical & Chemical Engineering

In these critical times when practically the whole world is one vast battle ground, every conserving influence for the preservation of food, steel, ships, or petroleum, is of importance.

In a warning given at Washington on May 25, 1917, Mr. Van H. Manning, director of the Bureau of Mines, stated that:

One of the serious problems confronting the United States at this time is the production and consumption of petroleum and gasoline in the United States. The situation is serious, and it is my purpose to give you a few of the essential facts and allow you to draw your own conclusions as to the remedies that ought to be applied. As a nation, we are wasteful, apathetic and forgetful. We waste our natural resources with shameful prodigality, we are apathetic of the future.

On July 22, 1917, Mr. A. C. Bedford, president of the Standard Oil Company of New Jersey, and chairman of the committee on petroleum of the Advisory Commission of the Council of National Defense, stated:

If our government is to have the petroleum it will need to prosecute the war successfully, and supply all necessities directly growing out of the war, two steps will have to be taken, namely:

1. The public will have to economize in the use of gasoline. Sufficient gasoline should be available to provide for the normal uses of automobiles. But pleasure riding should be curtailed. People should look upon their automobiles as necessities to be used only when needed. Not a gallon of gasoline should be used in the present emergency except for some useful end.

2. Every oil producer in the country should be encouraged as a patriotic effort to secure the utmost possible output of crude oil.

It is the purpose of this note to indicate that 700,000 barrels (in round numbers, 30,000,000 gal. of gasoline) could be saved in the refinery by eliminating the sulphuric acid, caustic soda, and washing treatment—in short, by marketing the gasoline direct from the steam stills.

The Federal Trade Commission's "REPORT ON THE PRICE OF GASOLINE IN 1915," contains the following data:

Year	All Gasoline Engines, Total Horsepower	Per Cent Increase	Gallons Gasoline Sold by All Refiners	Per Cent Increase
1913	11,279,143	...	1,099,350,000	...
1914	13,887,331	23	1,331,230,000	21.09
1915	22,524,838	62	1,849,790,000	38.95

The above table clearly indicates the greater increase in the percentage of gasoline-engine horsepower in comparison to the percentage increase in gasoline production. From 1913 to 1915 the total horsepower doubled and it is reasonable to believe that from 1915 to 1917, the increase will be quite as much. Since this increase seems to be assured, it is absolutely vital to this country that every gallon of gasoline be conserved, not alone on the ground of sound economics, but for the larger issues involved in this war. For the motor car and motor truck on the various battle fronts are the very arteries linking supplies and hospitals with the fighting men.

It has been estimated that in the year 1917, 70,000,000 barrels, or 3,000,000,000 gal. of gasoline will be marketed by the various refiners. In the refining of one barrel of gasoline average practice would show the use of at least 1 lb. of 66-Be sulphuric acid, with 0.1 lb. of caustic soda, and approximately  $\frac{3}{4}$  of a barrel of water for washing. This entails a loss of at least 1 per cent of gasoline due to treatment with sulphuric acid, caustic soda, and washing. Of course, it is recognized that if benzine is treated with acid (which is the practice in a number of plants) that there may be a slight variant from the above figures, but even then the loss would be well within the above figure of 1 per cent.

Tabulating the above values in terms of actual gallons and tons of material involved on the estimated amount of 70,000,000 barrels, or 3,000,000,000 gal. of gasoline to be marketed in 1917, there would result:

Loss of gasoline due to sulphuric acid treatment .....	700,000 bbl.	30,000,000 gal.
Tons of sulphuric acid used to treat 70,000,000 bbl. of gasoline...	35,000 tons	
Tons of caustic soda used to treat 70,000,000 bbl. of gasoline...	3,500 tons	
Water used in treating 70,000,000 bbl. of gasoline .....	52,500,000 bbl.	2,205,000,000 gal.

The above table excludes the costs of equipment and of handling the large quantities of material involved. The total cost of acid treatment adds considerably to the cost of gasoline per gallon, which is naturally shouldered by the consumer, giving him a highly questionable return in "better product" for the difference in cost.

The acid treatment of gasoline adds very little, if anything, to the value of the resulting product. The acid treatment removes unsaturated hydrocarbons from the gasoline, which hydrocarbons have a greater driving power in a motor than saturated or paraffine hydrocarbons. Moreover, the specification of a water-white gasoline as one of the tests of its fitness is much overrating its value to the gasoline.

There are no valid objections to the use of a gasoline with a tinge of color or so-called odor in it. Take as an example a cracked gasoline with a tinge of yellow in it. Refining with sulphuric acid to rid the gasoline of the tinge of yellow or slight odor does not add anything to the gasoline as a motor fuel. In short what valid objections are there to the use of a gasoline with a slight odor or a tinge of yellow or red as in the case of some cracked California gasolines?

In view of the above data as to the conservation of 30,000,000 gal. of gasoline, it seems advisable to the writer, not alone to conserve the gasoline but also the sulphuric acid, caustic soda, water treatment, equipment, and man power used in the unnecessary refining of gasoline as conducted to-day. The minimum saving in economic wealth would be \$10,000,000.

GUSTAV EGLOFF.

### Methyl Alcohol and Acetone as By-Products of the Soda Pulp Industry

*To the Editor of Metallurgical & Chemical Engineering*  
 SIR:—With reference to our communication produced on page 416 of your edition of April 15, 1917, we note that we have in error transposed the quantities of methyl alcohol, and acetone, higher ketones and aldehydes, respectively. The "Spirit Test," second line on page 417, first column, should read as follows:

Spirit test: 30 per cent methyl alcohol, and 70 per cent acetone, ketones and aldehydes.

BLAIR, CAMPBELL & MCLEAN, LTD.

GLASGOW, SCOTLAND.

### An Independent Company

*To the Editor of Metallurgical & Chemical Engineering*

SIR:—Permit me to correct an erroneous statement which appeared on page 150 of your number of Aug. 1, 1917, concerning the General Bakelite Company of which I am president. The General Bakelite Company, contrary to your statement is not a subsidiary of the Roessler & Hasslacher Chemical Company nor of any other company.

L. H. BAEKELAND.

GENERAL BAKELITE CO., NEW YORK CITY.

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### Coming Meetings and Events

American Chemical Society, Boston, Sept. 10-15.

National Safety Council, New York, Sept. 10-15, 1917.

National Exposition of Safety and Sanitation, New York, Sept. 10-15, 1917.

Third National Exposition of Chemical Industries, Grand Central Palace, New York, Sept. 24-29, 1917.

American Institute of Metals and Foundrymen's Association, Boston, week of Sept. 25 to 28, 1917.

Technical Association of the Pulp and Paper Industry.—Joint meeting with the Technical Section of the Canadian Pulp and Paper Association, Holyoke, Mass., Sept. 27 to 29, 1917.

American Electrochemical Society, autumn meeting, Pittsburgh, Oct. 3-6, 1917.

American Institute of Mining Engineers, annual meeting, St. Louis, Oct. 8-13, 1917.

American Gas Institute, Washington, D. C., Oct. 16-19, 1917.

American Society of Mechanical Engineers, New York, Dec. 26-29, 1917.

### Western Metallurgical Field

#### Labor Troubles Curtail Copper Production

The output of copper of the United States has been seriously curtailed as a result of a long train of labor troubles in the Rocky Mountain region. During the last month strikes of greater or less extent have multiplied in various mining camps from Alaska to Arizona;—in some places the difficulty of wages was no sooner adjusted than another strike against camp living conditions was declared. Kennecott, Butte, Globe-Miami, Clifton-Morenci, and Bisbee all have been practically shut down. In most of these places the Industrial Workers of the World,—or more properly known from their initials, the "I Won't Work"—were very active in fomenting the strikes, often openly avowing a purpose of handicapping the Government by crippling the copper producing industry. The situation was further aggravated by feuds between the I. W. W. and the International Union of Mine, Mill and Smelter Workers, headed by Charles H. Moyer, until it was impossible to find out just what the trouble was about, and what body of men should be approached with negotiations. The impossibility of any patriotic appeal to these men is evident from the fact that nearly half of the employees of the copper mines in some States are aliens, working here only to "make a stake."

Under such circumstances the demands made by many strikers were merely "hold-ups," and it is only a question of a short time when an ignorant, unskilled laborer now dissatisfied with \$5 a day and striking for \$6, will be striking for \$7 if he is given the present demand. In nearly all instances the present pay is based upon a sliding scale depending upon the price of copper, and consequently is now two-thirds greater than it was before the war.

In nearly all cases a settlement of the troubles has been made or is well under way, leading to an increase of wages of some amount up to about 50 cents a day. In the meantime exciting events, bloodshed, murder and treason have occurred. At Bisbee, after a double killing, a citizens' committee aided by deputy sheriffs loaded over a thousand I. W. W. members and sympathizers, both residents and floaters, into freight cars and escorted the train over the border into New Mexico, where the exported men were taken into custody by the Federal troops. At Butte a new scale at about 25 cents a day increase was adopted by the operators, and a reformation in the obnoxious "rustling-card" system instituted. Squabbles between various metal-worker unions prevent any general settlement, although the Federal mediator, W. H. Rodgers, has been able to conclude terms with most of the belligerents. The small hold of the I. W. W. on that community is evident from the comparative quiet following the lynching of one of their most violent agitators. In the meantime, however, hundreds of experienced miners have left the district rather than become involved in the trouble, and the scarcity of labor has thus been greatly accentuated.

#### The Leadville Strike

Unlike most of the strikes in the West, the Leadville strike was not an outcome of I. W. W. activities. It was simply a universal demand of the strikers for a raise in pay, based on the idea that with the present prices of metals the operators are making a greater

profit, and no attempt was being made on the part of the operators to raise the wages of the miners to balance the increased cost of living.

The minimum wages paid prior to the strike was \$3.50 per day. Several of the mines operating in the district used a sliding scale for wages based on the value of the individual, but still holding the minimum rate as stated above. In this manner daily wages as high as \$5.50 were paid to some of the laborers.

Within the past two years the wage scale of the district has been raised 16 2/3 per cent, that is, the minimum was raised from \$3 per day to \$3.50. The present demand of the miners was for an increase of \$1 over the \$3.50 per day. To this the mine operators objected, claiming that the profit made per ton of ore on such a basis would be so low that it would not pay to operate in the district. Leadville is a low-grade silver, lead, zinc camp and with the increase in cost of materials essential for mining operations, it would then be practically impossible to work the district profitably.

The situation was investigated by the State Industrial Relations Commission of Colorado, whose final findings were that the miners were not justified in their demands. It was found by the commission that the rents had not been increased for the past ten years. Food, clothing, shoes and other materials essential for the up-keep of the families of the miners had increased in the same proportion as the same goods had increased in Denver. Board had increased \$5 per month due to the increased cost of food. On the other hand, the operators were found not to receive anything like the full benefit of the increase in metal prices, due to the existence of old contracts and unequitable smelter schedules.

The mine operators then offered an increase of 50 cents per day to the minimum wages paid. This the miners refused to accept and all mediation on part of the governor and the commission seemed of no avail, but after a three-days session between the mine operators and the representatives of the labor faction it was decided that operations at Leadville be resumed on Aug. 2 based on the 50 cents per day increase.

The settlement of the trouble was made more difficult by the refusal of the mine-operators to treat with delegates of the union, feeling that it would only be an entering wedge for the same element whose domination terminated in a bloody struggle several years ago. The present union has enrolled far less than half of the miners of the district, and a bare majority of their membership voted the strike. This faction is generally thought to be the Austrian element in the union, and the strike was quite unpopular among the American miners.

**Midyear Spelter Report.**—The United States Geological Survey, from returns representing 99 per cent of the output, estimates that the production of spelter during the first six months of 1917 was 364,000 short tons, as compared with 351,000 short tons during the last half of 1916. Stocks on hand are estimated at 33,000 tons as compared with 17,600 at the beginning of the year. A large number of retorts, about 35,000, including fourteen complete plants, were reported idle June 30, in addition to the retorts engaged in refining prime western metal and in redistilling zinc ashes.

## Fuel Oil Situation Growing Serious in West

A report has just been completed by the committee recently appointed by Governor Stephens of California to make an investigation of the petroleum resources of that state, with particular regard to the industrial and military needs of state and nation in the present war emergency. The substance of the report was published in the *Engineering News-Record* Aug. 9, 1917.

The committee found that the oil production in California (whence comes one-third the entire supply of the United States and about one-quarter of the world's supply) is falling behind consumption at the rate of 35,860 bbl. per day. This excess of consumption over production is now being taken from oil in storage, and at the present rate the storage in California will be reduced to the 10,000,000-bbl. safety margin by Sept. 20, 1918. Should consumption increase or production decrease, both of which are likely unless immediate action is taken, the safety margin will be reached at an earlier date.

The seriousness of the situation is emphasized by the fact that considerable time is required to adapt power equipment for other sources of energy. It is pointed out in the report that fuel oil is largely used in the operation of the steam railroads of the Western States, the Panama Canal, steamship lines, cement plants, mines and smelters, gas plants, sugar refineries and, in general, a substantial portion of the manufacturing, industrial and agricultural enterprises of the Western States.

### CONSUMPTION EXCEEDS PRODUCTION

The oil production in California has not been increasing in recent years. In 1914 it was 103,620,000 bbl.; in 1915 it was 89,570,000 bbl.; and in 1916 it was 91,820,000 bbl. The production in 1917, indicated by the present conditions, would be about the same as last year. The report points out, moreover, that further substantial increases in the annual petroleum production cannot be expected through the discovery of new fields or large extensions of existing fields.

Throughout 1916 the consumption exceeded the production by an average of 1,100,000 bbl. per month, or 36,650 bbl. per day. During the first five months of 1917, consumption exceeded production by 5,415,000 bbl., or 35,860 bbl. per day. Of course, the storage has been reduced correspondingly. Although the total remaining storage on July 1, 1917, is reported to have been about 38,000,000 bbl., this would be reduced to a much lower figure if limited to available fuel oil, because a considerable percentage is light oil, is below tank outlets or is otherwise unavailable. The stored oil is owned principally by the Standard and Union oil companies.

The substitution of coal for fuel oil was considered in the investigation, and the conversion of steam railroads from oil to coal burners in regions adjacent to coal fields is touched upon in the report. However, apart from the changes already made or contemplated, there is little possibility of further conversion from oil to coal during the war, unless the conditions surrounding the production and transportation of coal materially change.

The substitution of hydroelectric energy has already taken place to a considerable extent in industrial and

agricultural uses, but this has been hampered by difficulty in securing copper and other material and also by the disturbance of existing conditions that would be entailed by diverting large blocks of hydroelectric energy to service previously rendered by oil-burning plants. Large additional oil saving through the substitution of hydroelectric energy cannot be expected during the war, the report states; but after the war and the restoration of normal industrial conditions, wherever hydroelectric energy is available it will play an increasingly important part as a substitute for the fuel. Meantime, interconnecting the transmission systems of electric companies is suggested as a means of eliminating or at least reducing the necessity of maintaining steam-electric plants.

#### RELIEF MEASURES

The difficulties standing in the way of prompt and substantial increase of production must be quickly removed, the report states, if a serious industrial crisis is to be forestalled. The emergency cannot be met without the assistance of the Federal Government, and the report urged that California state officials make direct appeal to the administration at Washington.

While it is believed possible to increase production more than 30,000 bbl. per day, this increase cannot reasonably be expected to be available before June 1, 1918. To secure the best and most immediate results the committee recommends:

1. That production be increased immediately, by additional drilling on the lands which can be developed in the least time with the smallest expenditure of material and labor.

2. That every effort be made to reduce field losses, to encourage the highest use of petroleum and its products and the substitution of other forms of fuel or power where possible.

3. That the Federal Government be promptly advised of the situation and asked to render every assistance possible.

4. That manufacturers of oil-well supplies and the railroads be directed to expedite the production and transportation of oil-well casing, drill stems, wire cables and similar material—bringing the influence of the Federal Government to bear, if necessary.

5. That all skilled workmen in the oil fields be exempted from military service.

6. That lands in litigation be developed either through the Federal receivers or through the claimants to the lands, with due regard to the rights of all parties. (In this connection it is notable that 70 per cent of the desirable undrilled lands are involved in litigation with the Federal Government.)

7. That additional lands be thrown open for development by the Federal Government.

8. That steps be taken immediately to correlate the transportation facilities of the railroad, steamship, oil-pipe and oil companies, that transportation may be expedited, and

9. That as far as possible the burning of unrefined petroleum be prohibited.

The committee, which is officially known as the Committee on Petroleum of the State Council of Defense, consists of Max Thelen, president of the California Railroad Commission; Eliot Blackwelder, professor of geology, University of Illinois; and David M. Folsom,

professor of mining engineering, Leland Stanford, Jr., University. The preliminary outline of the committee's report was telegraphed to Washington on July 7 by Governor Stephens, and a prompt acknowledgment was received by wire signed by President Wilson, expressing appreciation of the importance of the work and promising Federal support for the general plan.

### Boston Meeting of American Institute of Metals

The following tentative program of papers has been prepared for presentation at the meeting of the American Institute of Metals to be held in Boston, Sept. 25 to 28, 1917:

#### Crucibles and Furnaces:

- "The Crucible Situation," by Prof. A. V. Bleining, Bureau of Standards, Pittsburgh, Pa.
- "Melting Yellow Brass in New Form of Induction Furnace," by G. H. Clamer, Ajax Metal Co., Philadelphia, Pa.
- "The Crucible Situation," by M. McNaughton, Jos. Dixon Crucible Co., Jersey City, N. J.
- "The Electric Furnace & Non-Ferrous Metals," by Dwight D. Miller, The Society for Electrical Development, New York City.
- "My Experience with Metal Melting Furnaces," by W. H. Parry, National Meter Co., Brooklyn, N. Y.

#### Melting and Casting Non-Ferrous Metals:

- "Casting Bearings in Sand & Metal Molds," by R. R. Clarke, Pittsburgh, Pa.
- "The School End of the Job in Training Foundrymen," by C. B. Connelley, Dean, Carnegie Institute of Technology, Pittsburgh, Pa.
- "The Flux & Cleaner Question of Brass," by E. A. Frohman, S. Obermayer Co., Pittsburgh, Pa.
- "Negative Experiments on Waste Core Sand," by Dr. H. W. Gillett, Bureau of Mines, Ithaca, N. Y.
- "Pyrometers—Their Construction & Application," by John P. Goheen, Brown Instrument Co., Philadelphia, Pa.
- "Surface Tension & Deoxidizing of Metals," by W. J. Knox, Metals Deoxidizing & Refining Co., New York City.
- "The Briquetting of Non-Ferrous Light Metal Scrap," by A. L. Stillman, General Briquetting Co., New York City.
- "The Swelling of Zinc Base Die Castings," by H. M. Williams, National Cash Register Co., Dayton, Ohio.

#### Munitions, Etc.:

- "The Present Status of Tin Fusible Plug Manufacture & Properties," by Dr. Geo. K. Burgess, and Gurovich, Bureau of Standards, Washington, D. C.
- "Stellite," by Elwood Haynes, Haynes Stellite Works, Kokomo, Ind.
- "Fire Prevention in Large Industrial Establishments," by C. W. Johnson, Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.
- "The Use of Die Casting in Munitions," by Chas. Pack, Doehler Die Casting Co., Brooklyn, N. Y.
- "A Few Points on Alloy Patents," by Wm. J. Rich, Patent Office, Washington, D. C.
- "Shrapnel Bullets," by Harold J. Roast, The Jas. Robertson Co., Ltd., Montreal, P. Q.
- "Recent Industrial Uses of Aluminum," by F. G. Shull, Aluminum Co. of America, Boston, Mass.

#### Testing Non-Ferrous Metals:

- "Some Comparative Tests on Test Bars and Actual Castings," by W. M. Corse (The Titanium Alloy Mfg. Co., Niagara Falls, N. Y.), Buffalo, N. Y.
- "Analysis of Babbitts & Brasses," by E. W. Hagmaier, Buffalo, N. Y.
- "Standard Test Bars of 88-10-2 and 88-8-4, being the result of co-operative work of six foundries; a new series of tests," by C. P. Karr, Bureau of Standards, Washington, D. C.
- "The Expansion Coefficients of Alpha and Beta Brass" and "The Corrosion of Manganese Bronze under Stress," by Dr. Paul D. Merien, Bureau of Standards, Washington, D. C.
- "Corrosion of Brasses of the Muntz Metal Type," by H. S. Rawdon, Bureau of Standards, Washington, D. C.

"The Analysis for Cadmium in Brass," by Dr. F. Schramm, Bureau of Standards, Washington, D. C.

#### *Metallurgy and Metallography:*

- "The Electrolytic Production of Antimony," by Prof. D. J. Demorest, The Ohio State University, Columbus, Ohio.  
 "The Electrical Properties of Some High Resistance Alloys," by Prof. M. A. Hunter, Rensselaer Polytechnic Institute, Troy, N. Y., and F. M. Sebast.  
 "The Amorphous Theory in Metals," by Prof. Zay Jeffries, Case School of Applied Science, Cleveland, Ohio.  
 "The Uses and Metallurgy of Antimony," by K. C. Li, Wah Chang Mining & Smelting Co., Inc., New York City.  
 "Development and Reabsorption of the Beta Constituent in Alloys which are normally of the Alpha Type," by Prof. C. H. Mathewson, Dept. of Mining and Metallurgy, Yale University, New Haven, Conn., and Philip Davidson.

### **Great Interest in Coming Chemical Industries Exposition**

The exposition management reports that manufacturers, works managers, chemists and engineers all over the country are taking a very active interest in the Third National Exposition of Chemical Industries to be held in the Grand Central Palace, New York, week of Sept. 24, 1917. Numerous letters from men all over the American continent and from foreign countries as well, have been received at the Exposition offices.

The success of the former expositions have been heralded in European countries. This has stimulated these countries to seek a better knowledge of the remarkable growth of the American chemical industries.

While refraining from giving information on the nature of their exhibits, the information on hand shows that there will be a very great many in operation—not only to demonstrate what certain machines will perform but operations upon actual material showing actual manufacturing processes in many of the industries.

Exhibits from railroad companies, state, and land companies showing the natural resources available in their several sections for the chemical industries will be made. Not only will these exhibits show the resources in their natural state but in many cases, where such have been made, the samples of the finished materials they produce.

The U. S. Government through the Bureau of Soils will be represented and will have an exhibit illustrating the fertilizer situation, and more especially American sources of potash.

The program of the exposition published in part in the last issue bids fair to attract much attention. In one phase it will discuss the foreign trade opportunities that the American manufacturer now has presented to him, and how to gain and hold those markets. Another phase of the program covers the work of some of the war councils. It will be remembered that at the First Exposition Mr. Howard Gross was one of the speakers and there proposed a Governmental Tariff Commission. The appointment of that committee by the President is but of recent moment and it is an interesting thing to learn how that committee will operate. Dr. Grinnell Jones of Harvard University, who has been selected as chemist to the commission, will be one of the speakers. It is not unlikely that Dr. F. W. Tausig, the chairman of the commission, will be another speaker to enter into the national operation of the commission for all the industries, while Dr. Jones' dis-

cussion will be confined to the chemical phases of the commission's work. It is undoubted that these addresses will be of great importance to the chemical industries, supplying them with much valuable information as to what they may expect, and as to how they could assist the commission making its work more thorough, to have a stimulating effect upon the productiveness of the American chemical industry.

There will be a symposium upon the national resources at which men thoroughly familiar with them will discuss the great existing opportunities.

#### **Tentative Program**

Monday, Sept. 24.—Opening day.

Opening addresses by Dr. C. H. Herty, Dr. Julius Stieglitz, President American Chemical Society; Dr. C. G. Fink, President American Electrochemical Society; Dr. G. W. Thompson, President American Institute of Chemical Engineers.

Tuesday, Sept. 25:

Prof. M. T. Bogert, Chairman, Chemical Committee, National Research Council, "The Operation and Work of the National Research Council for the National Weal."

Dr. Grinnell Jones, "The Tariff Commission and Its Operation with Reference to the Chemical Schedule."

Wednesday, Sept. 26:

W. S. Kies, Vice-President National City Bank, "The Development of Export Trade with South America."

Dr. L. H. Baekeland, Naval Consulting Board, "The Future of the American Chemical Industry."

Meeting of the Technical Association of Pulp and Paper Industry.

Thursday, Sept. 27:

Symposium on National Resources for Chemical and Allied Industries, participated in by:

Mr. C. H. Crawford, Assistant to President of Nashville, Chattanooga & St. Louis Railway.

Mr. V. V. Kelsey, Chemist-Industrial Agent, Carolina, Clinchfield & Ohio Railway.

Dr. E. A. Schubert, Mineralogist-Geologist, Norfolk & Western Railway.

Dr. T. P. Maynard, Mineralogist-Geologist, Central of Georgia Railway & Atlantic Coast Line Railway.

Dr. J. H. Watkins, Geologist, Southern Railway.

Meeting of the American Institute of Chemical Engineers.

Friday, Sept. 28:

Meeting American Chemical Society, New York Section.

Papers to be announced later.

The motion picture program will be announced later, though the following firms have placed their films at the use of the exposition managers: The American Cyanamid Company, Barber Asphalt Paving Company, E. I. DuPont de Nemours & Company, General Electric Company, Eagle-Picher Lead Company.

**Production of Coal in 1916.**—Statistics compiled by the Geological Survey show the total production of coal in the U. S. in 1916 to have been 590,098,175 net tons as compared with 531,619,487 tons in 1915. The number of employees was 14,000 less in 1916, but the number of working days was 26 greater.

## The Principles of Filtration—II

By D. R. Sperry

In a previous contribution\* the fundamental law of filtration was deduced and found to be:

$$Q = \sqrt{\frac{2PKT}{R\%} + \left(\frac{KR_m}{R\%}\right)^2} - \frac{KR_m}{R\%}$$

In which:

- $P$  = Pressure.
- $T$  = Time of filtering.
- $K$  = Rate of deposition.
- $R$  = Resistance of the solids.
- $\%$  = Per cent of solids in the mixture.
- $R_m$  = Resistance of filter base.

Another factor to take care of the effect of temperature was deduced and it was stated that two other factors might be added to allow for the effects of the squeezing together of non-rigid solids under increased pressure and to take care of the effects of gravity through the agency of settling or sedimentation.

The purpose of this article is to verify the fundamental equation of filtration by an analysis of actual time-discharge curves from a filter.

### DERIVATION OF NECESSARY MATHEMATICAL TOOLS

Before it is possible to analyze a time-discharge curve from a filter a simple mathematical discussion is necessary.

Let us take the fundamental equation and simplify it by putting:

\*Metallurgical and Chemical Engineering, Vol. 15, No. 4, Aug. 15, 1916, page 198, by author.

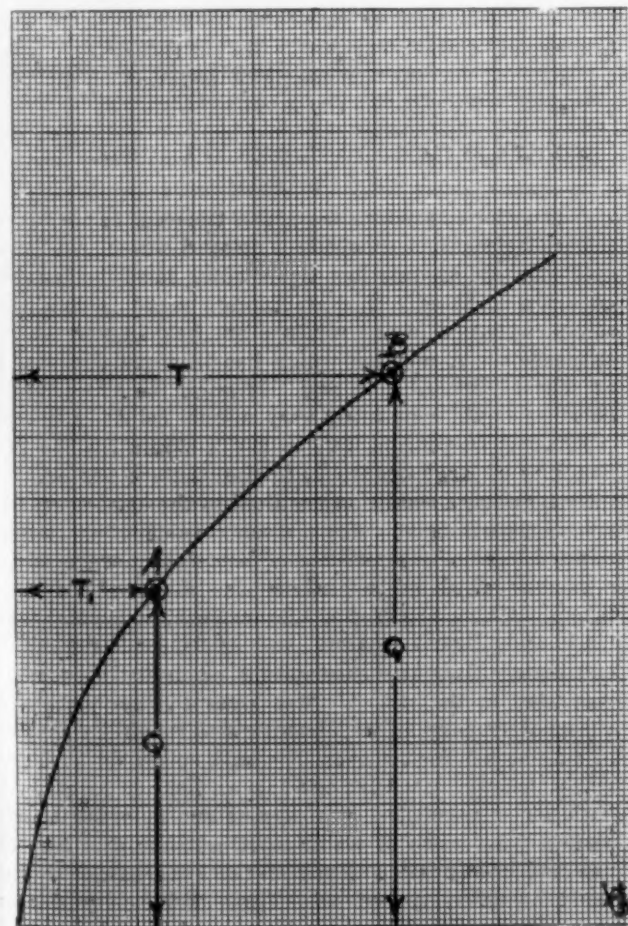


FIG. 7—TIME-DISCHARGE CURVE

$$\frac{2K}{R\%} = W$$

and

$$\frac{KR_m}{R\%} = N$$

The fundamental equation then becomes:

$$Q = \sqrt{WPT + N^2} - N$$

If we take a time-discharge curve from a filter and select two points thereon such as (A) and (B) in Fig. 7, whose respective locations are  $T, Q$  and  $T_1, Q_1$ , we know that

$$Q = \sqrt{WPT + N^2} - N$$

and

$$Q_1 = \sqrt{WPT_1 + N^2} - N$$

Squaring each of these equations:

$$Q^2 + 2NQ + N^2 = WPT + N^2$$

$$Q_1^2 + 2NQ_1 + N^2 = WPT_1 + N^2$$

or

$$Q^2 + 2NQ = WPT$$

$$Q_1^2 + 2NQ_1 = WPT_1$$

Multiplying the first equation by  $\frac{Q_1}{Q}$  and changing the sign we have:

$$-Q^2 \frac{Q_1}{Q} - 2Q_1N = -WPT \frac{Q_1}{Q}$$

$$Q_1^2 + 2Q_1N = WPT_1$$

Solving these two equations simultaneously it is found that

$$Q_1^2 - Q^2 \frac{Q_1}{Q} = WPT_1 - WPT \frac{Q_1}{Q} = WP \left( T_1 - T \frac{Q_1}{Q} \right)$$

or

$$WP = \frac{Q_1^2 - Q^2 \frac{Q_1}{Q}}{T_1 - T \frac{Q_1}{Q}}$$

$\frac{Q_1}{Q}$  is the ratio of the discharges corresponding to the two points A and B, hence it is appropriate to represent  $\frac{Q_1}{Q}$  by the symbol  $R$ , meaning ratio of the  $Q$ 's. Inserting this symbol for  $\frac{Q_1}{Q}$  in the foregoing equation there results:

$$WP = \frac{Q_1^2 - RQ^2}{T_1 - RT}$$

This equation is the mathematical tool which will be employed to verify the fundamental equation.

### USE OF MATHEMATICAL TOOL

If the fundamental equation is true, as assumed, then any pair of points taken on an actual time-discharge curve from a filter should give, when substituted in equation  $H$ , the same value of  $WP$  regardless of where the pairs of points are selected.

If a number of pairs of points are used on the same actual time-discharge curve and the resulting  $WP$ 's are approximately the same, the fundamental equation is verified.

### APPLICATION OF THE MATHEMATICAL TOOL

In securing a time-discharge curve from a filter the readings are always plotted commencing with the first rushes of liquid. Since in any filter base there is an

initial loss of solids through the openings therein, it follows that the time-discharge curve would vary from that corresponding to the theoretical. The initial loss of solids is called "leakage" and the effect is to augment the total discharge.

Another cause of variation from the theoretical in a time-discharge curve from a filter is lack of constant pressure conditions. In the writer's own apparatus it is quite impossible with a hand-pump to keep the pressure constant during the first few moments of a run.

The mathematical tool, equation  $H$ , should not therefore be applied to the time-discharge curve from a filter in the form ordinarily obtained. Application to such a curve because of the above errors would be misleading, and the values of  $WP$  obtained therefrom would not be similar.

#### AN AXIOM OF FILTRATION

In an effort to overcome these seemingly insurmountable difficulties an axiom of considerable importance in the field of filtration was deduced, namely, that the time-discharge curve from a filter may have its origin at any corresponding points of  $Q$  and  $T$  and upon analysis will produce the same values of  $WP$  as though the origin was at the actual commencement of the run. In other words, in order to analyze a time-discharge curve we do not require the entire curve but only two points on the same.

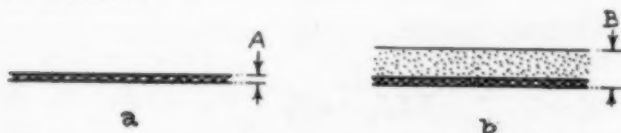


FIG. 8—CONDITIONS AT COMMENCEMENT AND DURING RUN

To better understand this statement the following explanation is given:

In Fig. 8 is shown at (a) the conditions at the commencement of a run. At the moment shown the total resistance to flow is that of the filter base of thickness  $A$ . In the fundamental equation this resistance corresponds to  $RM$ .

In Fig. 8, at (b) is shown the conditions when the point of origin of the curve is taken at some time later than at the commencement of the run. Here the resistance to flow is that of the filter base plus that of the cake already deposited, or the total resistance through thickness  $B$ . This resistance also corresponds to  $RM$  of the fundamental equation.

It should now be evident that the fundamental equation holds whether the run is started at (a) or at (b), Fig. 8. In the first case the initial resistance is that of the cloth only (if the filter base is cloth) while in the second case the initial resistance is greater, equal to the sum of the resistances of the cloth plus that of the cake deposited up to the initial point. The conditions in the second case are the same as though a cloth of resistance equal to sum of the resistances of the cloth actually used plus cake deposited at the time under consideration were employed. Hence it is a matter of indifference whether a run commences at the start of the process of filtration or at some other point—the analytical results would be identical as far as  $WP$  is concerned. This fact is a matter of importance not only because the difficulties always attending the commencement of a run can be very easily avoided by

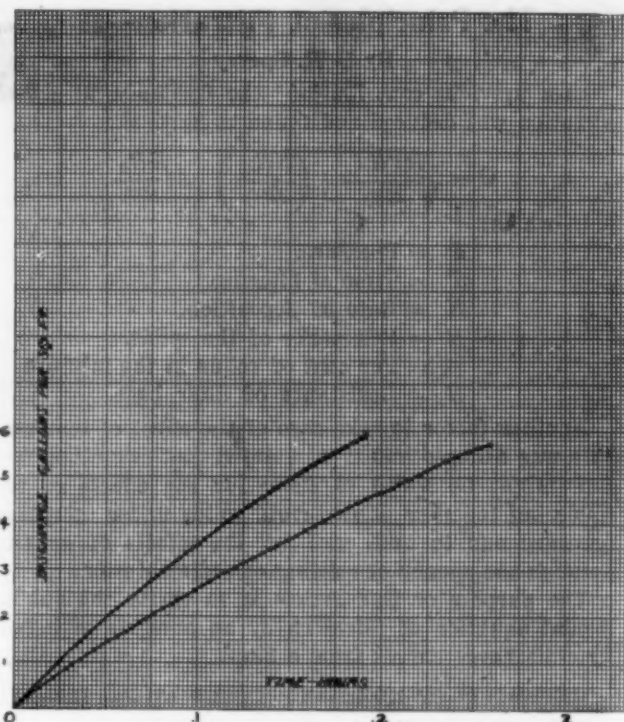


FIG. 9—TIME-DISCHARGE CURVES FROM SAME RUN, BUT HAVING DIFFERENT ORIGINS

its use, but also because one can analyze a discharge curve by taking only two sets of readings of time and discharge, both of which are referred to a common origin.

In Fig. 9 are shown two curves from the same run, but having different origins. Should these two curves be analyzed for  $WP$  by means of equation  $H$  the two values of  $WP$  should be the same.

#### MIXTURE EMPLOYED TO PRODUCE THE ACTUAL TIME-DISCHARGE CURVES

In order to produce the actual time-discharge curve a working medium should be employed which will coincide with the assumptions upon which the fundamental equation is based. One assumption made is that the solids contained in the mixture are held in permanent suspension. A medium which has this qualification is of course impossible to find. It might be practical to obtain a liquid containing very minute solids in nearly permanent suspension, but to use it would involve the handling of large quantities of the mixture per unit of filtering area, a condition unsuited to the hand-operated apparatus available. After much consideration it was decided to employ a mixture of Kieselghur prepared in a manner calculated to minimize the effects of sedimentation. A thin mixture of this material and water was made and allowed to stand and settle for a period of one hour. Only the supernatant or unsettled portion was used in the run. It was assumed that since the supernatant portion had demonstrated its ability to stay in suspension for an hour, it would surely do so for a run which was less than one-half an hour in length. A little experimentation was carried out in order to ascertain what ratio of water to Kieselghur was best to use and how great a depth of the supernatant liquor could be safely drawn off. Three 250 c.c. graduates were filled with different mixtures of Kieselghur and water. One had about a 2 per cent mixture, another

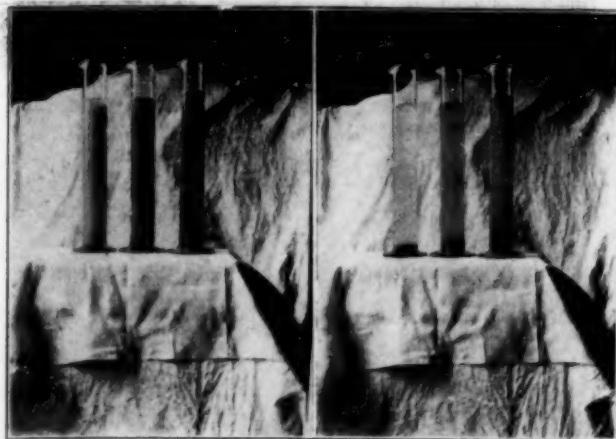


FIG. 10 — SHOWING THE  
THREE TEST MIXTURES  
BEFORE SETTLING

FIG. 11 — SHOWING THE  
THREE TEST MIXTURES AF-  
TER SETTLING ONE HOUR

about 1 per cent and the last about  $\frac{1}{2}$  per cent. The contents of each was thoroughly agitated and then allowed to settle for a period of one hour. Figs. 10 and 11 show the appearance before and after settling. It was found that a portion of the solids settled to the bottom. The line of demarcation between this portion of the solids and the opalescent upper portion was quite sharp. There was no selective suspension of solids in the upper portion as far as the naked eye could detect. The distribution of solids appeared to be uniform throughout, producing a liquid of the same opalescence from the line of demarcation to the surface of the liquid. It was decided to use as a working medium for the test a liquor corresponding to the upper portion of the sample containing the smallest amount of solids. Measurements showed that about 14 per cent of the total mixture consisted of the dense portion.

For the test the water and Kieselghur were mixed together in a receptacle shown in cross-section in Fig. 12. After agitation the mixture consisting of  $5\frac{1}{8}$  oz. of Kieselghur and 8 qt. of water was allowed to settle for one hour. At the expiration of this period the

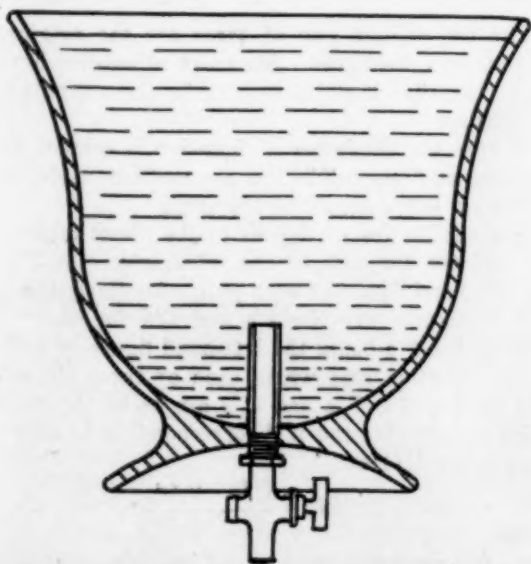


FIG. 12—CROSS-SECTION OF TANK SHOWING METHOD  
OF DRAWING OFF SUPERNATANT PORTION  
OF MIXTURE

upper portion was drawn from the lower portion by opening the drain valve. The height of the nipple inserted in the drain hole was such as to leave more than 18 per cent of the total mixture in the receptacle. This, according to the results of the test in the graduate given above, assured that none of the heavy mixture passed downward through the nipple and drain. It was found by a preliminary experiment that the nipple allowed  $1\frac{1}{2}$  out of 8 qt. to remain undisturbed.

The upper portion which passed out of the drain was used in the test. A pressure of 30 lb. per square inch was employed.

#### FILTER PRESS USED AND PLACE OF TEST

The apparatus employed is shown in Fig. 13, and arranged for this test as in Fig. 14. The frame measured 4 in. in height, and the mixture entered the upper head. The filter base consisted of No. 10 duck. Place of test, Basement Laboratory, 178 Union Avenue, Batavia, Ill. Date of test, Nov. 24, 1916.

#### OBTAINING THE TIME-DISCHARGE CURVE DATA

After agitation, the mixture stood in the receptacle from 2 p. m. to 3 p. m., after which the bottom drain was opened and about  $6\frac{1}{2}$  qt. of upper liquor drawn off and set aside in glass bottles. The above quantity was all that the height of nipple would allow to flow away. Next, the nipple was removed and the heavy liquor allowed to pass out. The receptacle was then rinsed, the drain closed and the upper liquor emptied therein from the bottles.



FIG. 13—FILTER PRESS AS  
USED IN THE FIRST TEST.  
THE STRAIGHT HORIZON-  
TAL INLET PIPE AND THE  
CURVED OUTLET PIPE CAN  
BE PLAINLY SEEN

By opening and closing appropriate valves, the liquor was caused to circulate freely through pump and piping to make sure that nothing but the prepared mixture would reach the filter.

Before closing the filter and immediately preceding the run the frame was filled with liquor. This eliminated air pockets and caused each run to start at almost the instant pressure was applied. After closing the filter the valve to same was shut and the pressure to be used in the test built up in the pump and piping.

In starting the run the valve to the filter was opened and the pump started simultaneously, the pressure being maintained as constant as possible. A bottle was previously put in position to catch the issuing filtrate. At the expiration of the first time-interval the first bottle was quickly removed and another substituted with no appreciable loss of filtrate.

Pressure was kept constant by placing weights on the handle of the pump. This acted as a pressure regulator, making it only necessary to raise the handle

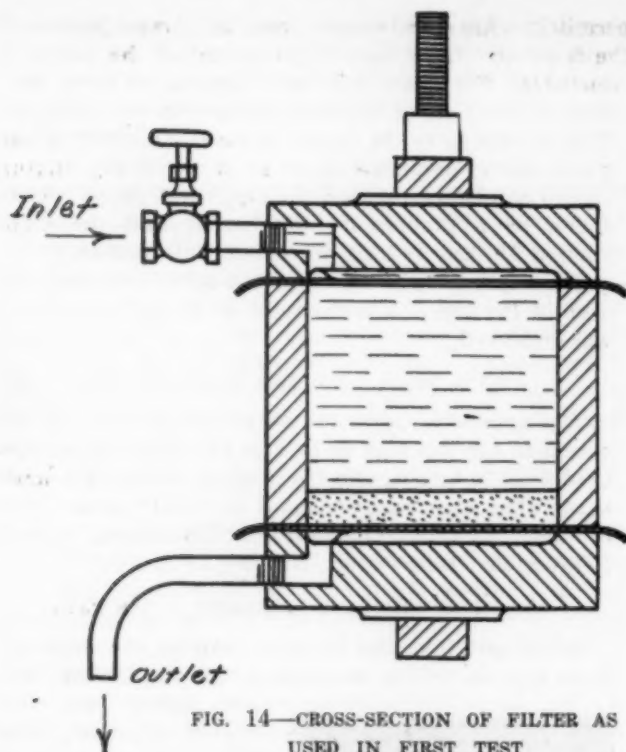


FIG. 14—CROSS-SECTION OF FILTER AS USED IN FIRST TEST

when it had descended by its own weight to a certain low position.

The pump used was a single-acting, outside-packed, 1½-in. x 3-in. plunger pump hand operated.

Simultaneous time and discharge readings were as follows:

Reading	Time	Interval Discharge in c. c.	Time Increment in Minutes
1	3.20	0	0
2	3.20½	524	½
3	3.22	339	1½
4	3.23½	294	1½
5	3.25	233	1½
6	3.27	256	2
7	3.29½	272	2½
8	3.32	238	2½
9	3.35	250	3
10	3.38	236	3
11	3.41½	249	3½
12	3.45	233	3½

In order to arrange these data in a manner to avoid as much confusion as possible when equation (H) is applied, the first two columns in the following tabulation were computed from the data above.

Reading	Time Intervals in Hours	Interval Discharge in Gallons per Sq. Ft.	Total Time in Hours	Total Discharge in Gallons per Sq. Ft.
1	0	0	0	0
2	.0125	2.772	.0125	2.772
3	.0208	1.793	.0333	4.565
4	.0250	1.555	.0583	6.120
5	.0250	1.232	.0833	7.352
6	.0333	1.354	.1166	8.706
7	.0416	1.439	.1582	10.145
8	.0416	1.259	.2	11.404
9	.05	1.322	.25	12.726
10	.05	1.248	.3	13.974
11	.0583	1.317	.3583	15.291
12	.0583	1.232	.4166	16.523

Fig. 15-A is the graph of these data. This, then, is the time-discharge curve as experimentally determined.

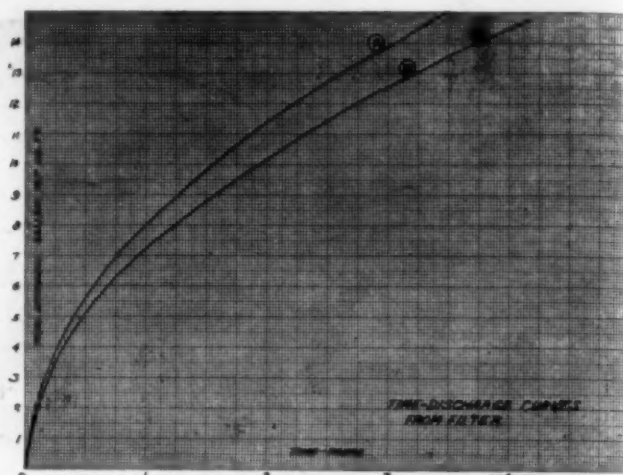


FIG. 15—TIME-DISCHARGE CURVES FROM FILTER

It now remains to apply equation (H) and see whether or not these practical results agree with the theoretical deductions.

#### APPLYING THE MATHEMATICAL TOOL.

Let us select the various origins at the points indicated by the zeros in the table below. The first origin is taken at run No. 4. This is done as previously explained to eliminate causes of error which are almost certain to exist in the first readings due to initial leakage and inconstant pressure conditions.

Reading No.	ORIGIN NO.					
	1	2	3	4	5	6
1						
2						
3						
4	0	0				
5		0	0			
6			0	0		
7				0	0	
8					0	0
9	.1916	6.608	1.666	5.375		
10				.1833	5.269	.1416
11					3.83	.10
12	.3583	10.4	.333	9.174	.3	7.82
					.2583	6.38
						.2166
						5.121
						.166
						3.798

The top oblique line of zeros are the origins, both of time and discharge. Six pairs of origins have been taken in order that there may be six computed  $WP$ 's to compare.

In case the fundamental equation is correct, and the working medium fulfills the assumptions made, then all of the six  $WP$ 's should be the same.

The middle line of figures in the above table are the  $T$ 's and  $Q$ 's for each of the six origins, the  $T$ 's being the left hand figure of each pair. Similarly the bottom row of figures are the  $T$ 's and  $Q$ 's for each of the origins, the  $T$ 's being the left-hand figure of each pair.

The equation into which each of these six different sets of  $T$ 's,  $Q$ 's,  $T_1$ 's and  $Q_1$ 's are to be substituted in order to solve for the  $WP$  corresponding to each origin is equation (H) or:

$$WP = \frac{Q_1^2 - R_0 Q^2}{T_1 - R_0 T}$$

In the tabulation below the  $T$ 's,  $Q$ 's,  $T_1$ 's and  $Q_1$ 's are listed, the other factors deduced, and the  $WP$ 's obtained:

Factor	ORIGIN No.					
	1	2	3	4	5	6
T	.1916	.1666	.1333	.1416	.1	.1083
Ti	.3583	.333	.3	.2583	.2166	.1666
Q	6.008	5.375	5.269	3.83	2.571	2.566
Q <sub>i</sub>	10.40	9.174	7.82	6.38	5.121	3.798
Q <sub>i</sub> <sup>2</sup>	43.67	28.89	27.77	14.67	6.612	6.585
Q <sub>i</sub> <sup>3</sup>	108.30	84.1732	61.1539	40.7164	26.2316	14.4319
R <sub>q</sub>	1.574	1.706	1.483	1.665	1.991	1.48
R <sub>q</sub> Q <sub>i</sub>	68.77	49.3161	41.2165	24.4464	13.170	9.74857
R <sub>q</sub> T	.301848	.284428	.27225	.23598	.19917	.1603
Q <sub>i</sub> <sup>2</sup> -R <sub>q</sub> Q <sub>i</sub>	39.531	34.857	20.943	16.273	13.061	4.6824
T <sub>i</sub> -R <sub>q</sub> T	.056476	.04891	.02745	.02235	.01756	.006289
WP	699.9	712.6	763.0	728.0	743.7	761.8

## DISCUSSION OF THE RESULTS

A study of the results obtained shows that the value of WP for the origins is nearly but not quite constant. The greatest variation is very small. Plotting these values as shown in Fig. 16 at A, one is at once struck with the fact that such variation as occurs is a consistent one, the WP's increasing in value the farther the origin is removed from the commencement of the run. This suggests that the variation is due to the changing of one or more of the constants represented by WP. Let us consider each of these factors as a possible cause of departure from the theoretical. As given previously:

$$WP = \frac{2KP}{R\%}$$

It is evident that either 2KP constantly increased or R% constantly decreased. P, the writer knows, did not increase as the pressure regulating device would not

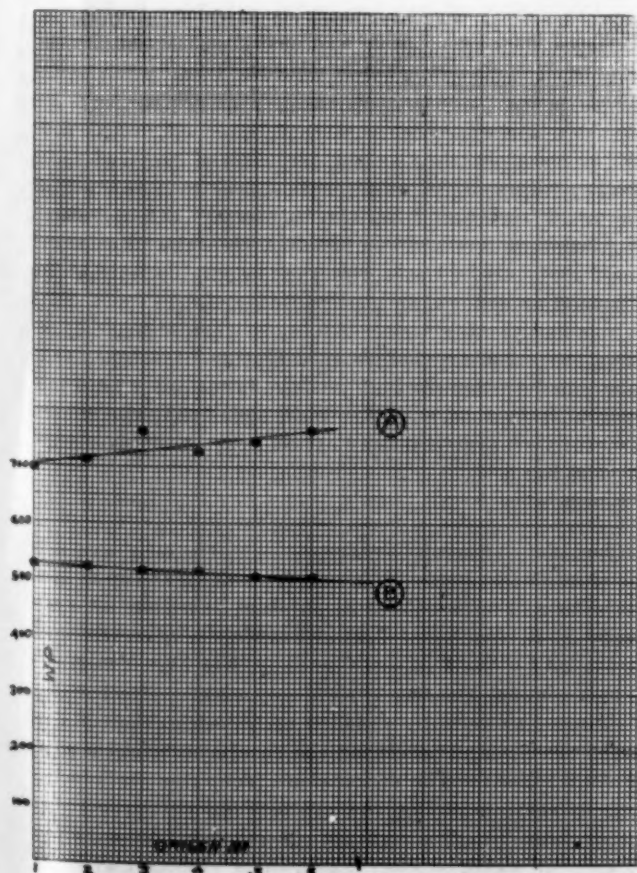


FIG. 16—RELATION BETWEEN WP AND DISTANCE FROM COMMENCEMENT OF RUN

permit it. An examination of the dried cake shows in the fracture no strata or other evidences of a varying resistance. The trouble therefore probably lies in "K," the rate of deposition, or in "%" the per cent of solids held in suspension.

## SEDIMENTATION PROBABLE CAUSE OF DEVIATION

Sedimentation within the filter press during the run might well account for the apparent variation of these two factors. If such is the case the WP's must be a very delicate measure indeed of sedimentation for it must be remembered that the mixture used was the supernatant portion of a mixture which had settled for one hour, while the run under analysis was only 25 minutes in length. The rate of settling in the mixture employed is undoubtedly approximately constant over a period of 25 minutes, while on the other hand the rate at which the cake is deposited by the process of filtration is not constant but decreases as the filtrate is discharged. In the case of origin No. 1 there was a certain thickness of cake already deposited at the start, at origin No. 2 a somewhat thicker cake had been deposited, similarly each succeeding origin has a thicker cake deposited at the start than the one preceding. Therefore the average rate of settling due to the process of filtration alone uniformly decreases as the origins are taken farther away from the commencement of the run, thus the total settling effect in each case is equal to the sum of the effect due to filtration, a decreasing quantity; and that of sedimentation, a constant quantity. The combined result being a decreasing sedimentation effect as the origin is taken away from the commencement of the run. This is in accordance with the results obtained and may therefore account for the variation. The effect is the same as though the rate of deposition K were increased or the per cent of solids %, decreased.

## MEANS OF PROOF AS TO WHETHER SEDIMENTATION IS CAUSE OF VARIATION

Obviously if the WP's increase as they are taken away from the origin when the settling effect due to

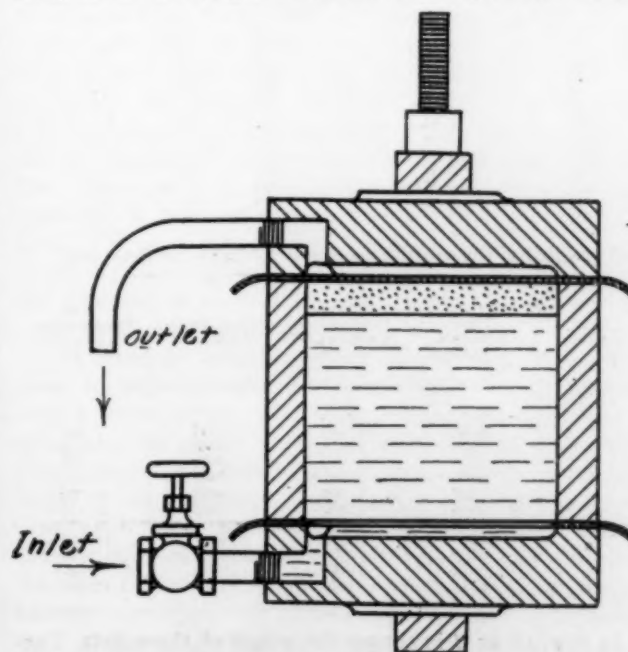


FIG. 17—CROSS-SECTION OF FILTER AS USED IN SECOND TEST

sedimentation acts in the same direction as that due to filtration it is to be expected that the WP's would do the opposite or decrease in value, as they are removed from the origin, in case the effect of filtration be caused to operate against that of sedimentation. If such is found to be the case it would serve to confirm the deductions already made, and tend to show that the fundamental equation is correct.

#### CAUSING SEDIMENTATION TO ACT AGAINST FILTRATION

In order to cause the settling effects of sedimentation and filtration to act against one another, the experimental filter press was arranged with the filter-base on the top side of the horizontal frame instead of below as in the first test. Fig. 17 shows a cross-section of the apparatus while Fig. 18 is a photograph of the filter press as used. The mixture employed was prepared precisely as was that used in the first test. The pump, the method of procedure and all else other than the location of the filter-base remained the same. Date of the test was Nov. 26, 1916. Mixture was settled from 3.35 p. m. to 4.35 p. m. Data readings were as follows:

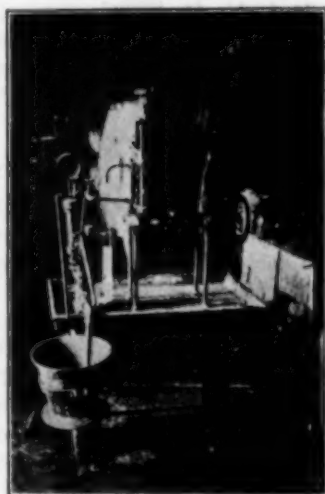


FIG. 18—FILTER PRESS AS USED IN THE SECOND TEST. THE RELATIVE POSITIONS OF THE INLET AND OUTLET PIPES AS COMPARED WITH FIG. 13 CAN BE EASILY NOTED

Reading	Time	Interval Discharge in c. c.	Time Increment in Minutes
1	4.46	0	0
2	4.46½	470	½
3	4.48	310	1½
4	4.49½	258	1½
5	4.51	203	1½
6	4.53	228	2
7	4.55½	247	2½
8	4.58	215	2½
9	5.01	230	3
10	5.04	208	3
11	5.07½	221	3½
12	5.11	203	3½

Arranging these data as done in the previous test:

Reading	Time Intervals in Hours	Interval Discharge in Gallons per Sq. Ft.	Total Time in Hours	Total Discharge in Gallons per Sq. Ft.
1	0	0	0	0
2	.0125	2.486	.0125	2.486
3	.0208	1.678	.0333	4.164
4	.0250	1.365	.0583	5.519
5	.0250	1.084	.0833	6.603
6	.0333	1.206	.1166	7.809
7	.0416	1.306	.1582	9.115
8	.0416	1.137	.2	10.252
9	.05	1.216	.25	11.468
10	.05	1.10	.3	12.568
11	.0583	1.169	.3583	13.737
12	.0583	1.074	.4166	14.811

In Fig. 15 at B is shown the graph of these data. The fact that this curve is somewhat lower than that of the first test is doubtless due to a slight difference in the

mixtures, the method of preparation permits a certain amount of error.

Arranging and selecting the origins in a manner similar to that done for the first test:

Reading No.	ORIGIN No.					
	1	2	3	4	5	6
1						
2						
3						
4	0	0				
5		0	0			
6			0	0		
7				0	0	
8					0	0
9	1916	5.951	1666	4.867		
10			1833	4.761	1416	3.455
11					10	2.317
12	3583	9.296	333	8.211	3	7.005
						2583
						5.698
						2166
						4.571
						166
						3.343

Solving for each of the WP's as done in the previous test, the following tabulation results:

Factor	ORIGIN No.					
	1	2	3	4	5	6
T	.1916	.1666	.1833	.1416	.1	.1083
T <sub>1</sub>	.3583	.333	.3	.2583	.2166	.166
Q	5.952	4.867	4.761	3.455	2.317	2.269
Q <sub>1</sub>	9.296	8.211	7.005	5.698	4.501	3.343
Q <sub>2</sub>	35.43	23.69	22.67	11.93	5.37	5.152
Q <sub>3</sub>	86.42	67.43	49.07	32.47	20.80	11.18
R <sub>q</sub>	1.561	1.686	1.471	1.649	1.968	1.473
R <sub>q</sub> Q <sub>2</sub>	55.33	39.97	33.35	19.68	10.81	7.59
R <sub>q</sub> T	.2993	.2810	.2697	.2336	.1968	.1595
Q <sub>2</sub> -R <sub>q</sub> Q <sub>3</sub>	31.09	27.46	15.72	12.79	9.99	3.59
T-R <sub>q</sub> T	.0590	.0523	.0303	.0247	.0198	.00707
WP	526.95	525.04	518.81	517.83	504.54	505.51

#### DISCUSSION OF RESULTS WITH INVERTED FILTER

Observing and plotting the WP's, as shown in Fig. 16 at B, it can be noted that the values are nearly alike, the variation such as it is being a consistent one and precisely the opposite from that observed in the first test, viz.: decreasing as the origins are removed from the beginning of the run. This serves to indicate that the small variation from the theoretical WP is caused by a very minute sedimentation within the filter press itself and substantiates the fundamental equation for filtration as deduced in a preceding article.

In subsequent articles still more theoretical discussions are necessary before the solution of actual problems can be attempted. The foundation of a new science must first be built firmly in order that the superstructure of practical application will be upon a substantial basis.

Batavia, Ill.

**The Wet Thiogen Process.**—The Thiogen process for eliminating sulphur dioxide from smelter fumes and converting it into elemental sulphur, invented by Professor S. W. Young of Leland Stanford University and controlled by the Thiogen Company, has been described in this journal March 15, 1917, page 309. The Bureau of Mines has recently finished an investigation of the "wet" process and published the results in Bulletin 133, by A. E. Wells. The conclusions from this work were that in some localities the process can be carried out successfully for the recovery of sulphur and sulphur dioxide in waste smelter gases on a commercial scale and at a cost of about \$12 to \$13 per ton of sulphur produced.

## Independent Laboratories in the Engineering Industries

By Clayton H. Sharp

The importance of laboratory work in connection with our national industries is more and more recognized, and there is no little discussion of suitable ways and means for promoting it. With the sharpened competition which must ensue at the close of the war which is now paralyzing the peaceful industries of the world, any and all means for increasing our industrial efficiency will be considered with a care which the easy-going times of the past has not accorded to them.

Our great manufacturing organizations are for the most part quite awake to the fact that laboratory testing and research are necessary and indispensable adjuncts to the growth and development of their industries. They realize that it is to the laboratory that they must look for radical or fundamental advances in the materials, methods and processes of production. They have established splendid laboratories and have attracted to them some of the greatest scientific men of the country. The product of these laboratories has been of enormous value—a value which cannot be measured in money, for it includes engineering and scientific discoveries which become the permanent possession of the human race and add to the prosperity and happiness of all future generations.

The manufacturers of smaller resources have not, however, made a correspondingly large use of laboratory assistance. This may be ascribed to two causes: first, that they have not been so fully aware of their own need for laboratory assistance and of the possibilities of laboratory work in increasing their efficiency, bettering their product, and broadening their scope; and second, because of practical difficulties in securing laboratory facilities which correspond to their needs. This paper is intended primarily to deal with the latter phase of the situation.

Laboratory or research work is commonly divided into two classes, both of which are important in connection with our national industries. First, there is the work in "pure science"—primarily the work of the university. Second, there is the work in "applied science," or in industrial research. Dr. J. J. Carty<sup>1</sup>, in his address as president of the American Institute of Electrical Engineers, has very clearly and aptly drawn the distinction between research in pure science and research in applied science when he said that it lies neither in the subject matter, which may be identical, nor in the methods, which may be the same, but in the motive. To quote his words:

"Industrial research is always conducted with the purpose of accomplishing some utilitarian end. Pure scientific research is conducted with a philosophic purpose, for the discovery of truth, and for the advancement of the boundaries of human knowledge.

The investigator in pure science may be likened to the explorer who discovers new continents or islands or hitherto unknown territory. He is continually seeking to extend the boundaries of knowledge.

The investigator in industrial research may be compared to the pioneers who survey the newly discovered territory in the endeavor to locate its mineral resources, determine the extent of its forests, and the location of

its arable land, and who in other ways precede the settlers and prepare for their occupation of the new country."

Evidently the industrialist who, to carry the analogy further, may be likened to the settler in the new territory, is dependent upon both classes of investigators; on the investigator in pure science because it is he who indicates the existence of a field heretofore unknown; on the industrial investigator because it is he who discovers the commercial possibilities which the field contains.

Further, the organization which is pre-eminently fitted to carry on the primary work of pure scientific investigation is the university. We must look to the university to discover and to foster the men having those rare and peculiar gifts of imagination, of transcendent patience, of unselfish devotion, which go to make up the explorer into the unknown regions of physical and chemical science. It is the university which must furnish these men the surroundings and the facilities which are required for the prosecution of their work.

For the adequate pursuit of industrial research, however, it is necessary to look to organizations constituted differently from the university. Industrial research having as its end the accomplishment of a definite result of commercial value accruing primarily only to the promoter of the work, it is evident that an institution organized like the university primarily for an educational purpose, and supported largely by endowments or by public funds, cannot justly devote any considerable portion of its energy or resources to any purpose which is not for the benefit of the public at large. The technical schools in this respect are in the same class with the universities with the important exception that a technical school is in general better situated for the conduct of industrial research work than is the university from the fact that its activities are along industrial lines. Hence we find that many of the great industrial corporations in this country have, as has been said, met their own needs by establishing their own private industrial laboratories. For the industries at large, however, this affords no adequate solution of the laboratory problem, for it does not apply to the multitude of concerns, individually smaller than the great corporations, but in the aggregate of enormous industrial importance. The importance of laboratory work to the smaller concerns is relatively just as great as to the larger ones (yet each by itself is unable to support economically and efficiently an adequate laboratory), and the problem is to find the best means of supplying their needs in this particular.

One possible solution is for the smaller manufacturer to take his laboratory problems to a technical school for solution. This plan, while it may work out admirably in many cases, is open to the objection which has been mentioned above, namely, that the funds of the institution, being given for a public purpose, should not be diverted to private ends. However, it may be urged that it is to the advantage of the technical school to accept a certain amount of industrial work, not only in research but also in testing. Such work necessarily brings both instructors and students into contact with certain practical problems of the outside industrial world, too often a world of

<sup>1</sup>Carty, Proceedings A. I. E. E., Vol. XXXV, page 1411, October, 1916.

which they know much in theory but little in practice. The effect of this contact cannot but be broadening and helpful to the technical school and to its students, and if this advantage is sufficiently substantial, the theoretical disadvantage of diverting the attention and the resources of the institution to a limited extent to matters which are particularly the affair of private individuals or corporations is more than counterbalanced. Added to this advantage to the technical school are certain others, among which may be mentioned that incidentally the inadequate salaries of the faculty may be augmented to some extent and the instructors thereby put into a position more nearly in accord with the demands which are made upon them. To the industrial concern a recourse to the laboratory of a technical school may offer the advantage of furnishing a service for a smaller expenditure than would be necessary if all of the overhead and incidental charges were included, which under similar circumstances a commercial organization would have to make.

As against the advantages so outlined there are certain disadvantages which must be given careful consideration and due weight. We have noted that taking on a piece of industrial work has the effect of bringing instructors and students into contact with practical industrial problems and thereby broadens their vision and increases their usefulness. To the industrialist who presents the problem, however, the very lack of knowledge of practical details very greatly lessens the value of the technical school as an organization for the accomplishment of his purpose. Every technical problem is surrounded by limitations and special conditions which may not appear to be of controlling importance (from an academic standpoint) but which if not given their practical weight annul the solution. Considerations of cost, of the intellectual and psychological limitations of workmen, of transportation, or market conditions, of company policy, of technical and commercial usage in the field—any or all of them may have their influence on the result. The technical-school men, if less in touch with practice, are evidently at a disadvantage in the solution of problems involving these elements. The technical school, being organized and equipped for purposes of education and not for purposes of testing or industrial research, is frequently at a disadvantage on account of the limitations of its laboratory equipment, or the amount of power available, and on account of the lack of a business or technical organization especially designed to prosecute industrial problems which it never was designed to handle, with promptitude, accuracy and engineering common-sense. It must be remembered that while many discoveries are made by laboratory experiments on a small scale, many of these are not applicable to industrial exploitation for the reason that elements which in small-scale experimentation are of negligible importance, often become controlling factors when the scale is changed to correspond to practical production. A chemist in his laboratory may effectually close a flask with a cork; a similar procedure does not apply at all to a spouting oil well. He may evaporate to dryness a dilute solution for the purpose of recovering a small residue and never once think of the gas which he uses in the process. If he were dealing, however,

with the same operation on a scale ten thousand times as big, the matter of fuel and of containing vessel might offer insuperable obstacles to commercial success. Small-scale experimentation teaches but little regarding the proper design of a switch to open a high-tension power circuit. Hence apparatus which is quite adequate for the small-scale work of the college laboratory may be entirely inadequate when experiments are required looking toward the industrial application of a process.

In speaking of this feature of industrial work in educational institutions, Dr. Steinmetz<sup>1</sup> in a recent address said:

"Unfortunately this limitation for research work in accordance with the available facilities is not always realized, and especially educational institutions not infrequently attempt research work, for which industrial laboratories are far better fitted, while research work for which the educational institution is well fitted, which the industry needs, but cannot economically undertake, is left undone."

Prof. James Swinburne<sup>2</sup>, in a lecture on "Science and Industry," delivered at Kings College recently, has pointed out that the instructor in technology tends as time goes on to be less and less in touch with practical conditions and more and more of an academic scientist. In general this is because only those are likely to take up the teaching profession who have less taste for engaging in the practical work of industry and their own successors are as a general thing the less practical ones of their own students. The academic scientist, on the other hand, is a master of his subject, for his science like himself is academic, and in his own field he is pre-eminent. Thus the tendency of the technologist to become academic is a tendency for him to follow his own proper bent and to employ his energies in the direction in which they will be most effective.

Since to refer the problems of the industry to the technical schools for investigation does not offer a satisfactory solution of the problem, some other way must be sought. This may be found along the lines indicated by Dr. Carty when he said:

"One of these is for the manufacturer to take his problem to one of the industrial research laboratories already established for the purpose of serving those who cannot afford a laboratory of their own. Other manufacturers doing the same, the financial encouragement received would enable the laboratories to extend and improve their facilities so that each of the small manufacturers who patronizes them would in course of time have the benefit of an institution similar to those maintained by our largest industrial concerns."

"Thus in accordance with the law of supply and demand, the small manufacturer may obtain the benefits of industrial research in the highest degree and the burden upon each manufacturer would be only in accordance with the use he made of it, and the entire cost of the laboratories would thus be borne by the industries as a whole, where the charge properly belongs."

Thus is assigned to the independent laboratory an important place in the engineering industries in providing for the smaller manufacturer laboratory facilities comparable with those enjoyed by some of the great corporations. To fulfill properly these functions the independent laboratory must be adequately supported, properly manned and abundantly equipped. Its staff must be organized on broad lines. Its engi-

<sup>1</sup>Journal of the Franklin Institute, Vol. 182, page 711, December, 1916.

<sup>2</sup>The Electrician, London, Vol. LXXVIII, page 182, November, 1916.

neers must be familiar with the practical and commercial features, as well as the technical details of the work which they encounter. It must include physicists and chemists accustomed to look at the fundamental features of the problems presented and to bring to bear upon their solution the methods and the point of view which are inculcated in the university laboratories of research, for the application of fundamental scientific principles to the solution of the problems of industry underlies all true industrial research. The fees charged by such a laboratory must be adequate to cover not only all expenses, but to yield a sufficient profit as well, for "unless industrial research abundantly supports itself, it will have failed of its purpose."

In return for the fees so paid the industrial research laboratory must deal with its clients in a highly confidential manner, conserving for them individually all the results of the work for which they are paying. It must be prepared to turn over to its clients the inventions and patents which are the direct outcome of any specific piece of work. It must organize its work efficiently, so that its costs are as low as is consistent with good work and so that the results are obtained without undue delay. As to equipment; this undoubtedly must be large. The variety of problems which will be brought to it will be of such scope that a great variety of instruments for measuring and for manipulation must be at hand. A very large supply of electrical power is an absolute requisite. These very conditions interpose serious obstacles to the establishment of laboratories of this character. Unless it is organized through the co-operative efforts of a considerable number of industrial corporations operating in the same or in similar fields, a difficulty is sure to be encountered in insuring beforehand its proper support. To some extent a laboratory of this sort must from its very inception possess an equipment representing a very considerable investment. Unless, therefore, the financial support is insured beforehand, no little faith is required on the part of those investing their money in it. When, however, it has been possible to establish a laboratory of this character, the scope of its work may be very large. It may, and should, include not only industrial research proper but ordinary and routine testing, such as is required by manufacturing concerns, by consulting engineers, and others. It should be prepared to make acceptance tests of manufactured articles on behalf of purchasers and a considerable part of its activities may lie in this direction. It should offer facilities to engineers, inventors, and experimenters to carry on laboratory work of their own under its roof and should make available to them all its own facilities.

In carrying out work of this great scope in an adequate and proper manner the independent laboratory will find itself side by side with the technical school as one of the potent features of industrial progress. The staff of such a laboratory would become increasingly efficient through the practical solution of problems of many kinds. The apparatus and other equipment would necessarily take on a diversified character such that new and unusual problems presented could be undertaken without the purchase or construction of special apparatus. As compared with

under-equipped and insufficiently-manned laboratories which individual manufacturers might establish for their own use with a most laudable spirit, independent laboratories, supported by formal or informal co-operation, would be far more efficient both as regards the cost of maintenance, the character and extent of the equipment, and the practical results to the industries. In the last analysis the availability and utility of such laboratories depend on the amount of material support which the industrial world is willing to accord to them.

New York City.

## By-Products in Electrolytic Copper Refining

By Lawrence Addicks

In a previous article on "Impurities in Electrolytic Copper Refining" (METALLURGICAL & CHEMICAL ENGINEERING, June 15, 1917) the various elements commonly associated with copper were discussed as impurities and their treatment carried far enough to get them out of the refined copper. We therefore left them as anode slimes and purifying plant salts or as furnace slags and flue dust. We have now to discuss the working of these impure metallurgical products into marketable materials.

### MARKET

We may broadly divide the possible by-products into three main classes as to their probable disposition as: First, those which are readily marketable in any quantity which such sources are ever likely to supply; second, those which have a limited and therefore sensitive and widely fluctuating market, and, third, those which have at the present time practically no market at all. These groups consist of the following: first, gold, silver, platinum, palladium, lead, nickel and antimony; second, bismuth, arsenic, cobalt, selenium; and, third, tellurium.

*Palladium* is the only uncommon member of class one. The production of this element is as yet quite small and this amount is readily absorbed by the jewelry and scientific-instrument trade. Practically it has the useful qualities of platinum, but is of about half the density.

*Bismuth* goes chiefly into the drug trade. Any large production of it floods the market and depresses the price. It is seldom associated with copper in any quantity, although it is the mainstay of electrolytic lead refining.

There is a large market for *arsenic*, which is used chiefly for its poisonous properties in insecticides, etc., but in recent years the great output of arsenious oxide recovered from smelter flue dusts has glutted this.

*Cobalt* is an element that has not yet found itself. The Canadian Government has conducted a wide investigation as to its possible uses, but aside from the use of cobalt oxide in the manufacture of smalt and for whitening yellow pottery and the use of the metal to give certain minor properties to cobalt-plated ware and cobalt alloys, no marked characteristic giving it a superior value to nickel has been discovered, and so far it has not been found possible to produce it at the price of nickel. Except in one or two notable cases, as in Katanga bullion, cobalt is not associated with copper to any extent.

*Selenium* was a rare element a few years ago; to-day

a single copper refinery could easily produce ten tons a month, could it be marketed. Its peculiar photo-electric property has not created any tonnage demand, and its only major use is for coloring ruby glass. This creates a steady but very moderate market.

*Tellurium* could also be produced by the ton, but there appears to be no reasonably extensive market for it. It would seem that the various plants producing selenium and tellurium could advantageously join in trying to develop wider markets for these elements by scientific research.

#### MARKET REQUIREMENTS

*Gold* is nearly always sold to the United States Assay Office. There are no requirements as to fineness, but the bullion is weighed, sampled and assayed by the Government. It is then purchased with a "gold check" on the Treasury Department for full value less certain refining charges. These charges are so adjusted that they are greater than those of an outside refiner, unless the gold is nearly pure; but the last traces of impurities are taken out by the government for less than it would cost others who are properly equipped. This is due to the fact that the government is not concerned with interest charges while the gold is in process, while the individual is very much concerned therewith. The result is that it is customary for the refiner to bring his gold up to perhaps 985 parts fine, the balance being chiefly silver (which is not paid for above 992) and sometimes small quantities of the platinum group of metals which are likewise forfeited.

*Silver* is largely exported to London in normal times because the English market is higher than the American by an amount usually sufficient to pay transfer charges. Under the present war conditions the freight and insurance on trans-Atlantic shipments has become so high that the profit in this movement has been wiped out, and America is beginning to make direct shipments westward to the market in the Orient.

The silver used locally goes to brokers, but little of the home consumption passing directly into the hands of the user.

The chief impurity in bar-silver is copper. For the American market it is customary to produce 999 fine, and for the English 998. As value over 998 is neglected in payments from abroad while penalties are exacted if it runs under that point, care must be taken to bring high grade electrolytic silver down in fineness. This is done when melting by the addition of copper wire in sufficient quantity to allow a safe margin above 998 for assay variations. Also, as only even quarter ounces are paid for it is customary to plug the bars with silver to a safe weight above an even quarter. The same result could be obtained by trimming but this would obscure any evidence of theft by trimming in transit.

*Tellurium* is the main metallurgical enemy of silver and must be thoroughly eliminated from it in order to prevent brittleness in subsequent rolling of the metal. Printed schedules of the charges of the U. S. Mints and Assay Offices are periodically issued by the Treasury Department and may be obtained upon application. The points of chief interest to a copper refiner in the present schedule are: first, all deposits are subject to a melting charge of \$1 per 1000 oz.; second, ordinary doré is charged 1 cent an ounce for parting and refining; third, gold bullion between 950 and 991.75 parts

fine is charged 2 cents an ounce for refining while silver contents in such bullion above 992 fine are not paid for; fourth, metals of the platinum group are not paid for, although their presence in quantity will be reported for the information of the depositor, and fifth, government weights and assays control, the weights being to one hundredth of an ounce and the fineness to the nearest quarter-part.

The *platinum group* of metals are sold as a rule in crude shape as a sponge or powder, running 950 fine or better. In passing, it may be of interest to state that the ordinary assay methods for the platinum group give very inaccurate results and that a true assay for platinum and palladium is a tedious and costly operation, involving repeated precipitations in order to free the platinum metals from the last trace of lead sulphate and silver chloride.

*Lead* is seldom present in any quantity unless it is added in the cupeling operation in the silver refinery. Its market requirements are too well known to need discussion here.

*Nickel* is used first, as nickel sulfate or as a double ammonium sulfate in nickel plating; second, as anodes; and third, as shot or oxide for steel alloying. The crude sulphate of nickel, iron and copper produced by a purifying plant can be made into a reasonably pure sulphate by wet methods. This is then broken down by heat into oxide which is in turn reduced by carbon to metallic nickel in an electric crucible. Carbon-free nickel can be made electrolytically from this product if desired. Nickel anodes are generally alloyed with more or less iron, although conditions in the trade are improving in this respect with a corresponding improvement in the character of nickel plating. The production of pure nickel salts is very troublesome and should not be attempted unless unusually pure electrolyte is available as a starting point. One of the large manufacturers of this product had so much trouble in meeting the strict requirements of the trade that wet methods of production were abandoned and the salt produced by dissolving pure nickel.

Electrolytic nickel should run 99.80 nickel plus cobalt and should be free from carbon and oxides. The cobalt should not exceed 0.3 per cent and the sulphur should be very low. Small quantities of iron and copper are permissible and a little arsenic is generally present.

Table I gives some examples of the crude by-product salt as made by the refinery which is the raw material for by-product nickel; also analyses of commercial single and double salts as found in the market.

TABLE I—ANALYSES OF NICKEL SALTS

Source	Type	% Ni	% Cu	% Zn	% Fe	% Co	% As	% Sb	% Pb
A	Crude	25.32	0.82	0.19	3.10	.....	1.27	0.29	0.05
B	Single	22.34	None	None	0.002	0.016	None	None	.....
B	Double	14.93	0.008	None	Trace	None	None	None	.....
C	Single	30.80	Trace	0.001	0.007	0.053	None	None	None
C	Double	14.80	None	None	0.003	0.067	None	None	None

An example of nickel made in the electric furnace from refinery by-product salt showed 98.98 per cent nickel, 0.29 per cent copper and 0.73 per cent iron.

*Antimony* is marketed chiefly in "metallic" form as its principal use is in the manufacture of alloys. It should be sufficiently pure to show clearly marked

"stars" on the surface of the pigs. It can also be marketed as a "hard" lead.

*Bismuth* is produced as metal in very pure form, usually obtained by electrolytic refining.

*Arsenic* is marketed as a 99 per cent arsenious oxide readily obtained by sublimation from many flue dusts.

*Cobalt* is marketed almost entirely as oxide. There are three oxides of cobalt and all have a market demand. They are difficult to prepare and the trade requirements are based on previous production rather than on any rational specification. The great use of cobalt oxide is as an offset to yellow cast in clay and similar material, the powerful blue characteristic of cobalt salts being equivalent to a bleach.

*Selenium* is produced in granular or fused form, 99 per cent pure. The black variety, not too finely ground, is desired by the glass industry.

*Tellurium* is usually offered in an impure state but no market standards have as yet been developed.

#### METALLURGY

The general treatment of the electrolyte for the recovery of a crude nickel sulphate has already been discussed in the previous article noted above. This method also gave a cathode sludge of arsenic and copper from which a certain amount of arsenious oxide could be recovered if desirable. The balance of the impurities were either lost in blast furnace slags or concentrated in anode slimes.

The analyses given in Table II are representative of such slimes. The wide variation in the composition is due to different conditions obtaining at different

Selenium and tellurium may be present in elemental form or as selenides, etc. Lead is probably as sulphate and much of the nickel, iron, cobalt, arsenic, antimony and bismuth in some oxidized form, but antimonates and analogous compounds as well as simple oxides may easily be present. In general the slime is in an oxidized condition since the prior processes in the converter, the anode furnace and during electrolysis are all strongly oxidizing. The less noble metals are all therefore more or less oxidized in the slime when drawn from the electrolytic tanks.

There is always a high percentage of copper present. In slimes from converter anodes this is due in part to undecomposed matte, but even in slimes from the purest anodes there is a considerable amount of very finely divided metallic copper to be found after all cathode needles, etc., have been carefully screened out. This probably comes from either mechanical disintegration of the anode under electrolysis or from chemical oxidation of cuprous salts formed at the anode. Any one interested in the various possible explanations of this action would do well to consult an article by Dr. Emil Wohlwill on anode disintegration in the 1903 volume of *Zeitschrift für Electrochemie*.

#### REQUIREMENTS FOR A SLIMES PROCESS

Perhaps the foremost requirement for a metallurgical process for the treatment of these complex slimes is that there shall be a minimum of loss of the precious metals. We are dealing with material which usually runs 35 or 40 per cent silver and half a per cent of gold (and at times much more). This means that every by-product must be retreated for values contained. The second question relates to the interest on metal value. The slimes are worth about \$5 a pound and a process is needed which will turn out the great bulk of the gold and silver promptly. A third desideratum is to be able to recover as by-products any marketable impurities which are present in commercial amounts. Then we have to consider the chemical questions introduced in the parent process of copper refining by the presence of any unusual reagents. Finally we have to reckon with the operating cost of the process in question.

This problem of treating anode slimes is doubtless the most difficult presented by the metallurgy of copper refining, and it is also the one which to-day leaves most room for further improvement. It has always afforded a field of contest for advocates of wet against advocates of fire processes; and the methods used at present employ a mixture of the two, the wet processes, however, steadily encroaching as time passes. We shall first discuss present practise and then the possible points of attack for further improvement.

The general problem as at present handled involves three main steps: first, the production of a nearly copper-free slime; second, smelting this to doré bullion; and third, parting the doré.

#### SLIMES BOILING

As sulphuric acid is a cheap reagent and as sulphate of copper is the basis of the electrolyte, the obvious method by which to remove the copper from the anode slime is to convert it into sulphate. As copper is not readily soluble in dilute sulphuric acid, however, either strong acid or some oxidizing agent such as air or nitre must be used.

TABLE II—ANALYSES OF ANODE SLIMES

Per Cent	RAW			BOILED	
	A	B*	C	D	E
Copper.....	14.3	43.3	20	1.60	1.14
Silver.....	35.0	17.2	37	41.5	29.5
Gold.....	0.64	0.12	0.6	0.7	0.7
Platinum.....		0.00017		0.0007	
Palladium.....				0.0006	
Nickel.....	5.25	0.08		0.80	1.07
Cobalt.....		0.006			
Arsenic.....	2.68	3.03	4	1.42	1.20
Antimony.....	5.35	3.46	8	3.84	5.70
Bismuth.....	0.46	0.11		0.37	0.20
Sulphur.....	1.69	13.21		2.48	1.97
Iron.....	0.17	0.36		0.24	0.26
Lead.....	2.44	0.76		7.33	18.60
Selenium.....	3.70	1.20		12.94	11.24
Tellurium.....	2.69	2.10		5.72	6.20
Zinc.....	Trace	0.09		Trace	Trace
Silica.....	4.40	0.18		5.29	4.71

\*Burns—Trans. A. I. M. E., Vol. XLVI, page 712.

plants and this lack of a uniform product has been one of the difficulties in the way of a wet treatment of slimes. *A* is an ordinary slime with nothing unusual in the composition. *B* is produced by the electrolysis of converter anodes; its nature is reflected in the high copper and sulphur contents. *D* and *E* are analyses after the slime has been somewhat oxidized and leached with dilute sulphuric acid to remove the excess copper; they show noteworthy amounts of selenium present. The high lead content of *E* results from anodes carrying 0.2 per cent lead.

There is room for division of opinion as to the exact compounds present in anode slimes. The silver, gold, and a large part of the copper in slimes from well-refined anodes are doubtless in metallic or alloy form.

The practice in the earlier plants was to screen the slimes through 60 or 70 mesh copper wire into agitators, using water to force the slimes through the screen. These agitators were lead-lined tanks about six feet in diameter and six feet deep, carrying a two-bladed paddle 2½ in. from the bottom and driven 12 rotations per minute. The blades tended to raise the slimes from the bottom. A charge consisted of perhaps 1000 lb. of slimes. After these were sluiced down into the tank liquor was siphoned off and enough sulphuric acid added to make a 50 per cent solution. A steam pipe heated the charge to the boiling point, the paddles were started and 100 lb. soda nitre added, a few pounds at a time. Owing to the strong evolution of poisonous nitrous fumes the nitre was added only at night and the treatment extended over two and sometimes three nights when the copper was found to be reduced to perhaps 3 per cent. The liquors made were sent to the electrolyte after carefully settling to free them from slimes.

After agitating, washing, and settling the charge, the supernatant liquor was siphoned off and the slimes, now running about 60 per cent moisture, dried to a thick mud carrying 25 per cent moisture by means of closed steam coils. This mud was considered ready for charging into the reverberatory refining furnace.

This method has been subject to many variations in details. At some plants compressed air is used for agitation instead of the paddles. Drying has been accomplished by the use of filter presses, of centrifugals or by direct heat instead of steam. It remained the general method, however, until the development of cyclical purification of the electrolyte which system made objectionable the introduction of large quantities of sodium salts into the electrolyte.

This difficulty was first met by charging raw slimes high in copper directly into the doré furnace. As will be later explained, such a procedure locks up a large quantity of silver in circulating by-products and is very undesirable.

The next step was the development of slimes-roasting and air has now come into general use as an oxidizing agent. In some cases an ordinary roasting hearth is used and in others patented<sup>1</sup> forms of tray hearths, but in any case all that is necessary is to expose a shallow layer of slimes to a low heat with sufficient air passing to hold the temperature below the fritting point (the slimes often ignite and overheat from the heat of oxidation), while being very careful not to stir the bed, and produce dust losses. The resulting calcines are then leached with dilute sulphuric acid which readily reacts with the cupric oxide found in the roasting.

A third process, which is patented,<sup>2</sup> mixes the filter-pressed slimes with concentrated sulphuric acid in sufficient quantity to satisfy the copper present, and heats this mud in a furnace the hearth of which is a steel basin. The slimes and acid are mixed first and pumped into the furnace. The mass is heated to about 450 deg. Fahr. with an oil burner and the mud occasionally stirred. The residues are practically dry and yield their copper sulphate readily when digested in hot water. This operation uses but a chemical equivalent of acid which is an advantage in some cases.

These various oxidizing and leaching processes designed to separate the copper from the rest of the slimes

can be made to bring the residues down to 1 per cent or less in copper, with careful handling. The other elements present are also more or less affected by the operation. During the process more or less silver sulphate is formed, but this at once reacts with the copper present to form copper sulphate and metallic silver. In fact boiling is generally continued until the presence of silver in solution is shown by a salt test. When a decided precipitate is shown a small quantity of raw slimes is added to precipitate this silver and it is then certain that sufficient work has been done to oxidize practically all of the copper. In roasting the more volatile elements sublime to a certain extent and such flue dusts are a fruitful source of selenium, for example. Solutions from the boiling tanks always show nickel, arsenic and antimony extraction.

#### SMELTING TO DORÉ

Whatever be the method employed in leaching the bulk of the copper from the slimes, the residue is always smelted to doré in some type of reverberatory furnace. Were the slimes subjected to a quiet fusion three layers of molten material would form with a distinct separation by specific gravity. At the bottom would be a foul doré bullion; in the middle would be what could be called a matte, silver being the principal metallic component and selenium substituting for the usual sulphur; then on top would be an arsenic-antimony slag.

TABLE III—ANALYSIS OF LEAD CUPEL SLAG

	Gold	Silver	Copper	Lead	Iron	Silica
Skimming.....	0.0017	1.62	5.42	32.51	4.87	14.02

TABLE IV—ANALYSES OF DORÉ FURNACE PRODUCTS

Per Cent	Slimes	1st Slag	2nd Slag	Doré	Flue Dust
Copper.....	2.39	4.25	7.90	2.00	0.1
Silver.....	40.0	4.03	3.31	96.345	5.0
Gold.....	0.767	0.041	0.0041	2.37	0.017
Nickel.....	1.94	7.58	1.02	0.0065	.....
Arsenic.....	2.34	1.593	0.73	0.0075	2.65
Antimony.....	5.91	11.34	3.30	0.0084	10.9
Bismuth.....	0.343	0.5378	0.64	Trace	.....
Sulphur.....	2.80	0.264	0.90	.....	.....
Iron.....	0.23	5.63	3.88	0.1233	.....
Lead.....	5.43	6.14	2.78	.....	.....
Selenium.....	11.89	1.58	11.06	0.0020	35
Tellurium.....	5.45	1.80	19.36	0.0068	1.5
Zinc.....	.....	Trace	Trace	None	.....
Silica.....	4.25	19.90	2.26	.....	.....
Alumina.....	.....	4.93	2.15	.....	.....
Magnesia.....	.....	1.604	1.31	.....	.....
Lime.....	.....	1.075	0.18	.....	.....

It is quite possible to base a process on such a fusion of raw slimes with subsequent separation and special treatment for the three resultant products. However, we should get but about half of the silver and most of the gold in a bullion around 900 fine, while most of the balance of the silver would be tied up in the copper-silver-selenium-tellurium matte. This matte is a troublesome material to handle without making undue losses or tie-up of silver, and it is because the quantity made is more or less proportional to the amount of copper present that it is desirable to eliminate this last element as far as possible before smelting.

The earlier work was done in cupels with the addition of lead, the process being in a cycle of charging, melting, skimming, cupeling with a blast, skimming and pouring. Something like 10 per cent of the lead used in this process would be lost, and the resulting slag

<sup>1</sup>Wales, U. S. Patent.

<sup>2</sup>Keller, U. S. Pat. No. 1,110,493.

(Table III) would have to be retreated on a lead basis and therefore was generally shipped elsewhere.

Then the use of lead was abandoned in favor of straight reverberatory smelting in small basic furnaces, air being forced under the surface of the bath to promote oxidation. It is interesting to note in passing that the silver furnaces of to-day are as large as the copper reverberatories in the earliest refineries. The general plan of operations is to melt the charge, thin the first slag with such fluxes as silica, soda ash, salt cake, etc., skim, blow the small quantity of matte to a second slag and bullion, skim, fine the doré with air and nitre, skim, and pour. Table IV gives representative analyses of the various metallurgical products produced by such a procedure. While the various columns are not all strictly comparable, they are near enough so to give a good idea of the character of the products. Had not the matte made been charged back or broken down before skimming we should have had another product running about 26 per cent silver and 0.02 per cent gold.

It is interesting to note the relative concentrations of the various elements in the different products—the slimes produce roughly 30 per cent first slag, 15 per cent second slag, 30 per cent doré, and 20 per cent flue dust, plus volatile losses and minus fluxes and furnace material. Perhaps the most striking thing is the "spreading" of the silver-gold ratio, nearly all the gold going directly into the doré while the silver spreads over the various by-products. This ratio as the figures stand is as follows: Slimes, 52.2; first slag, 98.4; second slag, 806; doré, 40.6; flue dust, 29.3.

The gold content of the slags is quite satisfactory metallurgically, but the silver is entirely too high. When the slag is reasonably fusible, it is possible by desilverization—consisting of a melting and collection of the suspended values—to bring the silver down to 0.5 per cent, but as these slags are all retreated in the anode furnace this seldom pays.

The elements which do not readily form fusible slags and therefore float undigested on the surface of the bath and those (such as lead, iron, and antimony) which on the contrary form slags very readily, tend to concentrate in the first slag. It is such an impure and unpromising material that it does not offer much chance for the recovery of by-products. Were the nickel out of the way it could be reduced to an impure antimonial lead.

The second, or soda slag really represents impurities subsequently blown out of the base bullion and matte formed when the slimes were melted. Here we have a decided concentration of tellurium, an element which clings tenaciously to silver. Since sodium salts are generally soluble, over half the total contents of this slag can be leached out with hot water. This is the starting point for the recovery of tellurium.

The small quantity of nitre slag made when fining the doré is charged back into the furnace with the next lot of slimes.

The flue dust shows a remarkable concentration of selenium and it is from this source that the market demand is supplied. Elemental selenium may be readily prepared from this dust in several ways—by fractional sublimation, by leaching followed by electrolytic precipitation, or by leaching followed by chemical reduction. The last-named method is perhaps the most satis-

factory. The leaching is generally conducted in the presence of hydrochloric acid and a strong oxidizing agent such as a chlorate and preferably exposed to sunlight. The resulting solution is strengthened in free hydrochloric acid in order to hold back the tellurium, and the selenium is then precipitated as a red powder by sulphur dioxide gas. This powder is melted and skimmed to a bright face, when it is cast into cakes as the black variety. If desired, the powder can be dried in an oven, the heat changing it to the black variety and the baked product then ground for the market. Selenium often runs 99.5 per cent Se and the chief impurities are lead sulphate, arsenic, antimony and tellurium. The lead content is the most difficult to control.

#### PARTING THE DORÉ

We have two well recognized methods available by which to part gold and silver—the sulphuric acid and the electrolytic. Both are in use and have their advocates but the latter has come into more general use chiefly on account of its greater cleanliness.

In the acid method, the doré is cast into slabs resembling waffles, the indentations giving additional surface for corrosion. The process is very simple, being the production of silver sulphate by the decomposition of strong, boiling, sulphuric acid by silver, sulphur dioxide being given off. The gold is left undissolved and is melted in a crucible, while the silver sulphate, which is readily soluble in excess of free acid, is precipitated upon copper sheets to form sponge silver which is washed and melted. The copper sulphate solution is sent to the copper-refining tanks.

The plant required is inexpensive—needing only a couple of cast-iron pots, a lead-lined tank and a crucible furnace—and the tie-up of values is short, being about 48 hours. On the other hand the process is dirty; hot sulphuric acid is hard to handle; and the fine silver cannot be brought below a third of an ounce in gold. Also, if the doré is high in gold, the acid attacks it slowly and it is necessary to inquant it.

The hot liquor from the kettles runs about 600 grams per litre silver and twice as much free acid. This has to be diluted with water before the silver is precipitated, and the tank house must be able to absorb this free acid. The kettles are fired up and boiled until no solid pieces of doré can be felt with a stirring rod. This takes about eight hours. The liquor is drawn off to a heated settling kettle to free it from entrained gold, fresh acid is added, and then given an additional boil to free the gold of silver. By washing the gold precipitate thoroughly before adding this acid it is possible to make 995 gold sand directly in the kettle. The silver sponge should run 998 or better.

The electrolytic process consists of the electrolysis of doré anodes in a copper-silver nitrate electrolyte. Three methods have been employed—the Thum-Balbach, the Moebius and the Whitehead. The first method uses horizontal carbon cathodes laid as the floor of a shallow earthenware tank, the anodes being carried in a basket within a light cotton bag to collect the gold slimes. At an efficiency of 90 per cent, 3.5 volts per cell is equivalent to a recovery of about 32 oz. silver per kilowatt-hour. The current density is limited to about 35 amperes per square foot by the heating of the electrolyte, as a hot solution means a high loss of free nitric acid.

The silver crystals have to be frequently removed in order to prevent treeing, which will reach and puncture the gold bag.

The electrolyte consists of about 4 per cent copper as nitrate, 2 per cent silver as nitrate, and 0.1 per cent free nitric acid. Copper enters from the doré and silver dissolves in a certain excess, nitric acid being regularly added, but the entrained liquor in the silver sponge removed holds the balance steady. The wash waters from this sponge are not returned to the parting tanks. There is no circulation of the electrolyte and each cell is a complete unit.

The silver crystals are readily washed with water and if the copper in the electrolyte is low, silver very close to 1000 fine can be produced. As this is not desired, however, the copper is allowed to build up to a maximum of perhaps 6 per cent in the electrolyte before any deliberate removals are made.

There is no anode scrap as the remnants of anodes are left in place on the horizontal trays until they are entirely consumed. Cathode silver runs 0.1 oz. per ton in gold or even better.

The gold mud is periodically removed and boiled in strong sulphuric and in nitric acids to remove the silver. This mud is also the raw material for the re-

covery of platinum and palladium, as mentioned later.

The Moebius process substitutes a vertical system of electrodes which is very much more compact and yields more silver per kilowatt-hour, due to lower tank resistance. The silver crystals drop to the bottom of the tank, in some plants being knocked from the cathode by a simple system of swinging wooden rakes. The anodes are inclosed in sacks. Against the cheaper first cost and somewhat lower power required, there is more care required to prevent gold leaks, the cell is not so open to constant inspection, and there is a small amount of anode scrap made.

The third system, which I have called the Whitehead plan, has not come into general use, although it has been more or less extensively employed at some of the government plants. It uses gelatin to obtain a coherent deposit to be stripped from silver cathodes and duplicates in many ways the conditions found in a copper refining cell.

As compared with the sulphuric acid method of parting, the products are more pure, there is less danger of metal loss, in a large plant the operating costs are somewhat lower, and but little by-product liquor is made. On the other hand the first cost of plant is much greater, in a small operation the operating costs are no

lower, while the metal tie-up is at least 50 per cent more.

If platinum and palladium are present in the doré we have the choice between electrolytic and chemical recovery. If the gold slimes from the parting are boiled to dissolve their silver in sulphuric acid, these metals remain with the gold which can then be electrolyzed by the Wohlwill process in a chloride electrolyte; if nitric acid is used in the gold boiling, the platinum and palladium go chiefly into solution and after a somewhat tedious treatment may be recovered as double chlorides with ammonium. The platinum is thrown out singly by sal ammoniac from a reduced solution; after oxidation the palladium may be similarly precipitated. Metallic sponges are obtained upon ignition of these precipitates. As these sponges are difficult to melt the metal is usually marketed as a crude powder. The separation between the two metals is quite sharp and a product 98 per cent or better is readily obtained.

The Wohlwill process has two great objections: it ties up a very valuable metal and it exposes it to possible theft. In ordinary practice the gold does not ap-

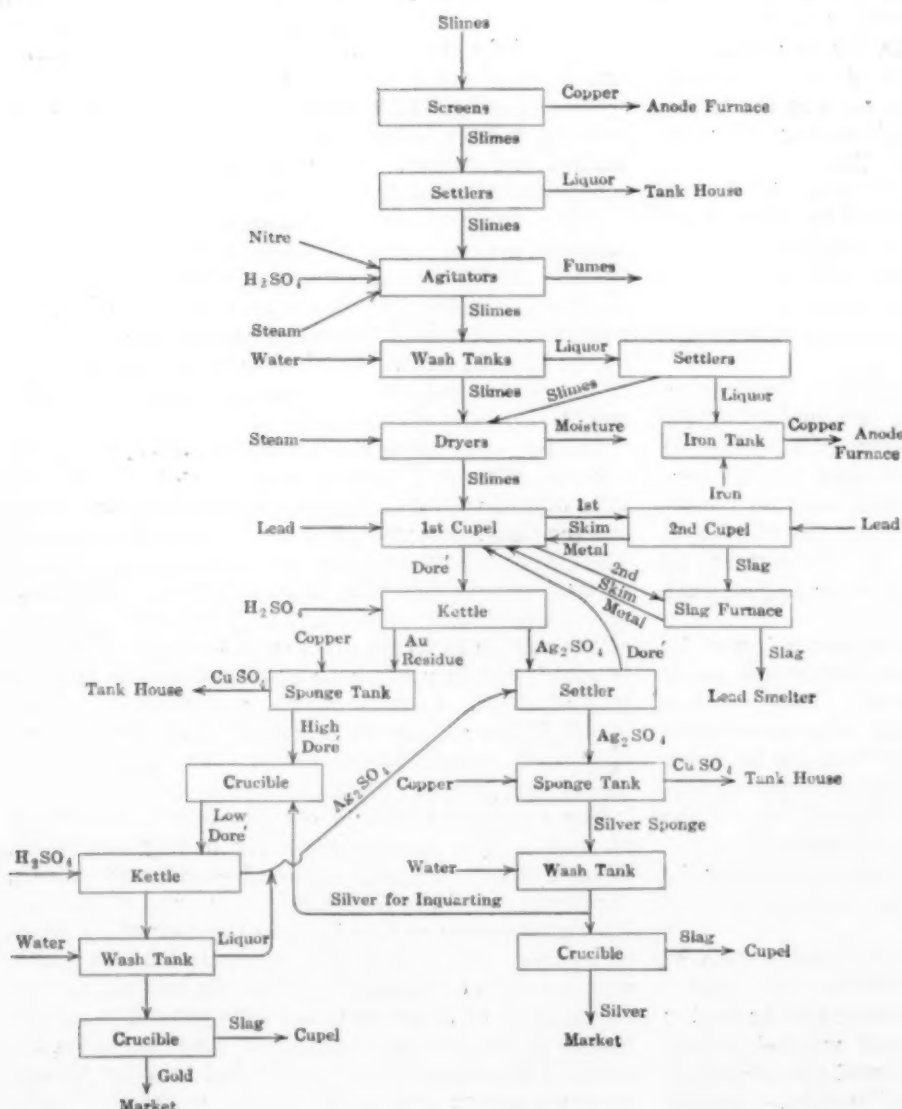


FIG. 1—SLIMES PROCESS 1900

pear in solid yellow metal until it is almost ready to ship. Crude, dirty products are hard to sell and do not present the same temptation to laborers handling them. On the other hand the electrolytic process is cleaner, as in the case of silver parting, with the result that most government plants use electrolytic and most private plants chemical extraction. As before stated, the government does not pay for platinum contents of deposits; one reason for this is that the assay method for accurate results is very tedious and expensive and its application would result in great delays in making settlements.

#### SLIMES PROCESS DEVELOPMENT

The progress already made with the metallurgical problems presented by copper anode slimes may be seen from Figs. 1 and 2 which are flow sheets representing practice twenty years ago and to-day. We may now consider the various points at which the second process may be attacked.

#### SCREENS

The fact that a certain part of the copper carried in the slimes may be removed by simple screening suggests the possibility of further separation by mechanical means.

The first point of attack here is against the size of the particle—could the slimes be classified in any way by screening? The practice at one plant is to screen out nodules and large pieces by passing the slimes through a 4-mesh screen, and then through a 70-mesh screen, which takes out float slime such as was discussed in Table VI in the last article.<sup>2</sup> Changing the size of this fine screen and then analyzing the slimes gave the results shown in Table V, below, which indicate the hopelessness of such a classification.

A screen analysis of slimes is given in Table VI. Here we happen to have a sample which has some small cathode debris present and the effect of screening this out is at once apparent upon the copper assays and the use of one fine screen is justified. In Table V the assay is for the total slimes passed by the screen while Table VI gives results for a true screen analysis. A 70-mesh screen will ordinarily retain 8 or 9 per cent of the weight of slimes sent it from the 4-mesh, and this quantity may be advantageously returned to the anode furnace.

As the silver and gold are presumably present in metallic form and as they have a higher specific gravity than most of the other elements present, some gravity separation might classify the product. Careful trials with a Wilfley table did not effect sufficient separation, however, to enable any process to be built on such a basis. It is just possible that the application of recent flotation experi-

TABLE V—ANALYSES OF SLIME THROUGH DIFFERENT SIZE SCREENS

Mesher per Inch	Per Cent Copper	Per Cent Arsenic	Per Cent Antimony
— 4	21.3	6.00	2.44
— 80	19.6	5.39	3.10
— 120	19.4	5.50	3.92
— 200	21.3	4.30	3.60

TABLE VI—SCREEN ANALYSIS OF SLIMES

Mesh Passed	Mesh Retained	Grams	Per Cent Weight	Per Cent Copper	Grams Copper	Per Cent Total Copper
4	20	319.1	55.6	40.8	130.2	74.3
20	40	101.4	17.6	27.0	27.4	15.6
40	60	54.0	9.4	22.0	11.9	6.8
60	80	30.8	5.4	13.7	4.2	2.4
80	100	14.4	2.5	10.6	1.5	0.9
100	.....	54.3	9.5	Not run	.....	.....
Total.....	.....	574.0	100.0	30.6	175.2	100.0

ence might show something of value. It must be remembered that what is necessary is not so much a perfect separation—any process will have to work up its intermediate products for precious metal values—as a scheme whereby the great bulk of the silver and gold will be put on the market promptly, leaving

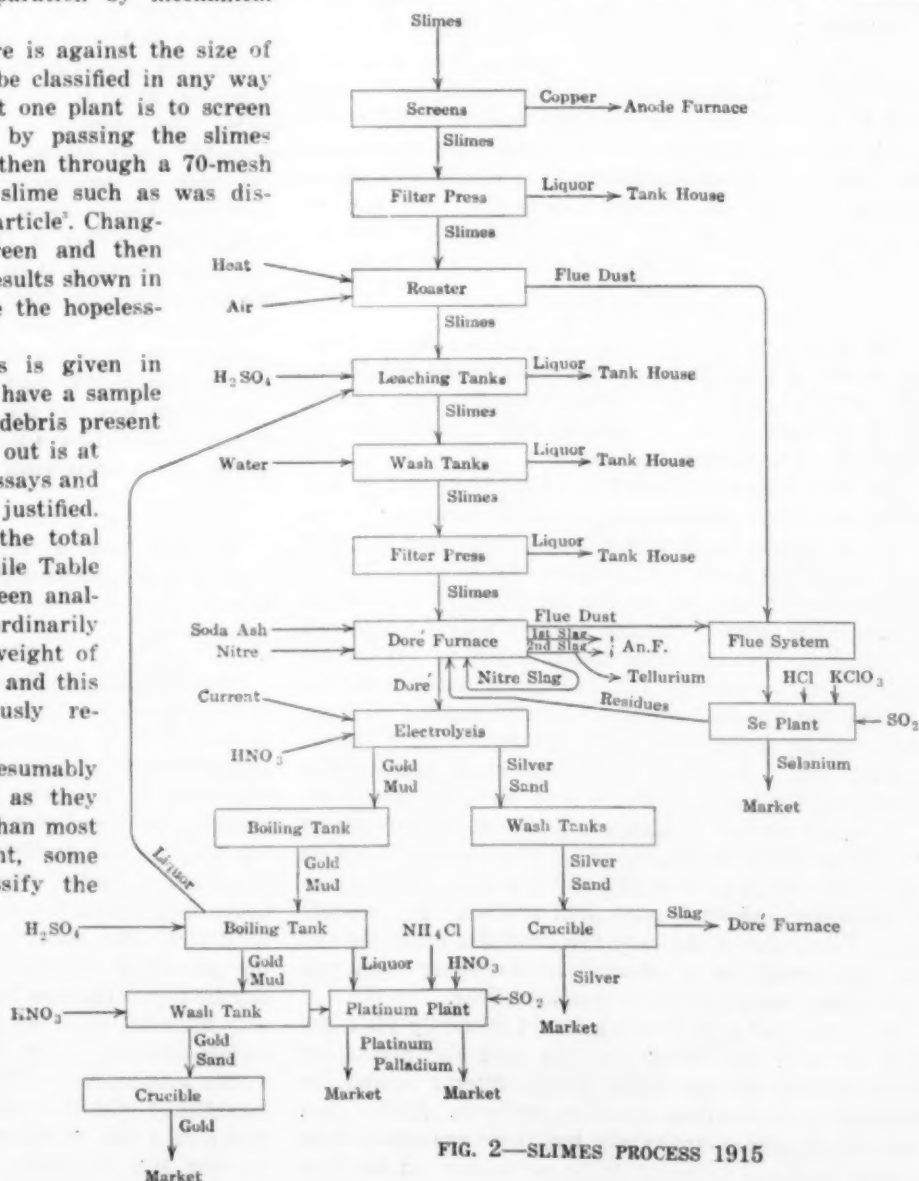


FIG. 2—SLIMES PROCESS 1915

<sup>2</sup>Impurities in Electrolytic Copper Refining. METALLURGICAL & CHEMICAL ENGINEERING, Vol. XVI, June 15, 1917, p. 687.

the more tedious working of other by-products until the last. One of the objections to present practice is that the other elements are gradually removed until the pure silver and gold are obtained, thereby holding the entire value until the very end of a long process.

#### OXIDIZING THE COPPER

The next step in the present process is oxidation of the copper. It has already been pointed out that the presence of any quantity of copper in the doré-furnace charge makes a serious amount of by-product matte high in silver. If the copper is allowed to stand at 15 or 20 per cent and the slimes charged directly into the furnace, instead of obtaining 30 per cent first slag, 15 per cent second slag and 30 per cent doré we should get perhaps 35 per cent slag, 25 per cent matte and only 20 per cent doré, a third of the silver being tied up in the matte. The desirability of the awkward oxidation step has therefore been fully demonstrated.

In the endeavor to simplify this operation, considerable work has been done experimentally with ferric sulphate as an oxygen carrier using the well known reactions:



and



A diaphragm cell is all that is necessary to carry out this process and chemically it is very pretty. The fact that it has not been successfully applied even in the hands of those skilled in electrolysis bears witness to the great difficulties interposed by a diaphragm cell in an acid process. Later work such as that of Hybinette in nickel or the use of a chemical retarder (Addicks, U. S. patent No. 1,138,921) may reopen this field.

#### LEACHING

The next step of dissolving the oxidized copper from the slimes is true leaching, and leads to the consideration of the possibility of dissolving the bulk of the slimes at once instead of making this a mere preparatory step to furnacing.

The first suggestive point to be noted is that in any of the oxidation processes it is easy to carry the action to a point where large quantities of silver may be taken into dilute sulphuric acid solution as sulphate. It is further known that by careful temperature regulation, a very high grade selenium product may be obtained in the flue. On the other hand, anything but an incipient roast tends to frit the easily melted slimes, spoiling the physical condition for subsequent leaching and forming undesirable chemical compounds of copper, arsenic, etc. Roasting therefore offers possibilities which are limited by difficulties in practical operation.

A second method of attack is to digest the raw slimes in boiling strong sulphuric acid. This readily dissolves nearly the entire content and yields a very foul solution of sulphates and an impure gold residue. Fortunately silver forms one of the very few insoluble chlorides and the plan would be to precipitate the silver with salt and reduce the chloride to metallic silver.

We have now a plan which would promptly yield the bulk of both the silver and the gold for marketing while leaving the less valuable constituents behind for working up into various other by-products. Such a plan may yet develop commercially but there are again some serious practical problems to be overcome. In the first

place a certain amount of flour gold is formed and it is very difficult to keep this away from the silver chloride precipitate. If the latter is not free from gold it has to be parted, incurring corresponding delay and expense. Silver sulphate is not a readily soluble salt and a considerable bulk of valuable liquor has to be handled. The reduction of silver chloride can be done electrolytically or chemically but even that is not complete and the question of small quantities of chloride being volatilized during melting has to be considered.

On the gold side we have a sludge carrying lead and antimony as well as the gold, and this involves fluxes and slags in the refining.

The other elements are collected in a bulky, dilute solution carrying sulphates and chlorides and any simple separation is a chemical problem of no mean order.

#### SMEETING

Another possibility lies in directly melting the raw slimes in a furnace with separation of slag and matte leaving most of the gold and half to two-thirds of the silver in a doré bullion which can be quickly fined and parted. The slag can be returned to the anode furnace as at present and the matte subjected to some special process.

The direct blowing of this matte in a small Bessemer converter is the most obvious method. We would get a selenious oxide fume and a copper-silver blister as the products, which would be quite satisfactory metallurgically. The difficulty is in the lack of courage to face the probable silver losses. Now that the Cottrell process has been so successfully applied to silver flue losses (Aldrich Transactions American Electrochemical Society, Vol. XXVIII, p. 119) this might be reconsidered.

Another method is to pulverize this matte and leach the values, pre-roasting if desired. This really means leaching out the copper and we have simply rearranged the steps in the original process so as to more promptly release part of the values.

Smelting has the advantage that a fair separation of other impurities is made in concentrated form, easily stored for retreatment.

#### PARTING

This step is in a very satisfactory state of development and but little improvement in methods is to be looked for.

New York City.

**Proposed Large Metallurgical Works for Spain.**—At the general meeting of the Sociedad Española de Construcción Naval, recently held at Madrid, the directors proposed and were empowered to proceed with the preliminaries of a scheme for large works to supply the necessary material required by the national arsenals and the shipbuilding industry, such as forgings, castings, shapes, and special steels of every kind and copper, brass, and special bronze articles for which Spain has, until now, been dependent on foreign countries, and in the procuring of which the difficulties are increasing day by day. The aim henceforth will be that ships and war material must be built in Spain entirely of materials produced in the country, for which purpose large works with an annual output worth £1,000,000 are to be established with the technical co-operation of a British group at a cost of about £800,000.—*Iron & Coal Trade Review*, July 13, 1917.

## Some Notes on Sulfonating Kettles

By Frederick Pope

In this discussion I will consider the various methods of controlling temperatures in sulfonating kettles, methods of agitation, and forms of kettles.

Sulfonating kettles are made of cast metal, for instance, cast iron or various acid resisting metals such as Duriron, Tantiron, Corrosiron, Buffokast, etc., the ratio of depth to diameter and shape of bottom varying widely according to the service required of the kettle. Kettles are ordinarily discharged either through the bottom or through a permanent or temporary tube inserted through the top, in which case air pressure is used to empty the kettle.

Fig. 1 shows a frequently used type of sulfonating kettle. The kettle itself is made of cast iron. The jacket may be either cast iron, or more often, boiler plate. Such a kettle is useful for such sulfonations as require either no external supply of heat, or a supply of heat at a low temperature.

Usually the source of heat is low pressure steam in the jacket, the steam being admitted through openings around the top of the jacket, and the condensation drawn off through an opening at the bottom.

This type of jacket is used when the source of heat is hot water, or when cooling water is used to control the temperature within the kettle.

When the kettle is heated by low pressure steam, a space of 1 to 2 in. between the outside of the kettle and the inside of the jacket is sufficient, but when hot water is used for heating or cold water for cooling, the space should be at least 4 in. These figures are for

medium sized kettles, say in the neighborhood of 4 to 5 ft. in diameter. When either hot or cold water is used, care must be taken that it is introduced at a number of points, and drawn from a number of points to prevent hot or cold streaks in the jacket.

Steam jackets of this sort carefully designed and well built may be used for temperatures up to 130 deg. C. The jacket should be carefully insulated with asbestos or other non-conducting covering.

An example of a kettle of this sort is the one used in the sulfonation of benzol to benzol sulfonic acid, which is heated to a point between 80 deg. and 110 deg. C., depending upon the method used, and is equipped so that water may be admitted into the jacket for cooling in case of overheating.

When a higher temperature than 110 deg. C. is desired, we have a more difficult problem because if we use steam as our source of heat for heating the kettle, higher pressures are necessary, and we have the awkward problem of cylinders of large diameter subject to collapsing pressure from the outside.

A number of methods have been devised for solving this problem. Superheated water is successfully used abroad in place of high pressure steam. Fig. 2 shows one method of designing a kettle for high pressure steam. Here coils of wrought iron pipe are placed in the mold for the kettle, and cast iron is poured around them. It is reported that this construction is successful abroad, but according to available data has never been very successful in this country, the difficulty being the difference of coefficients of expansion between the wrought iron and cast iron. It presents a very at-

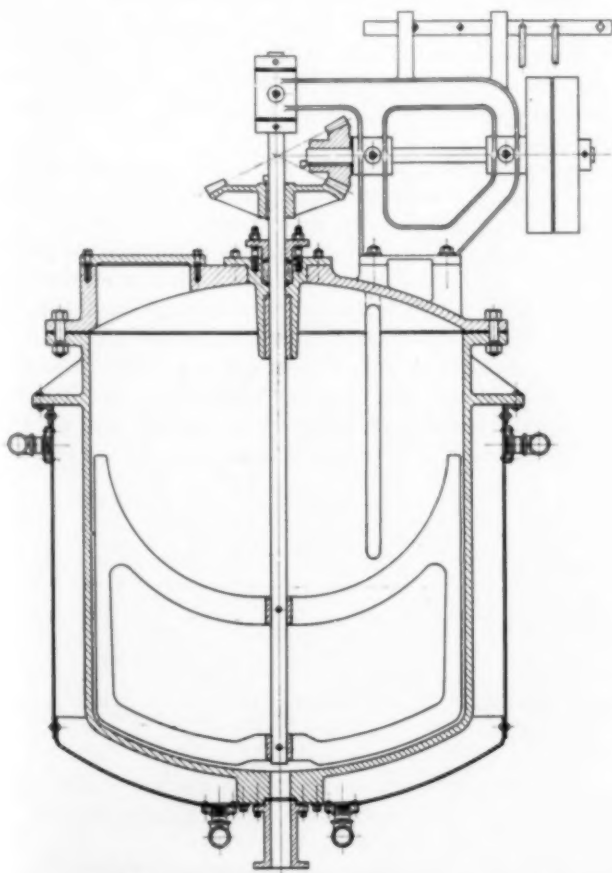


FIG. 1—CAST IRON SULFONATING KETTLE

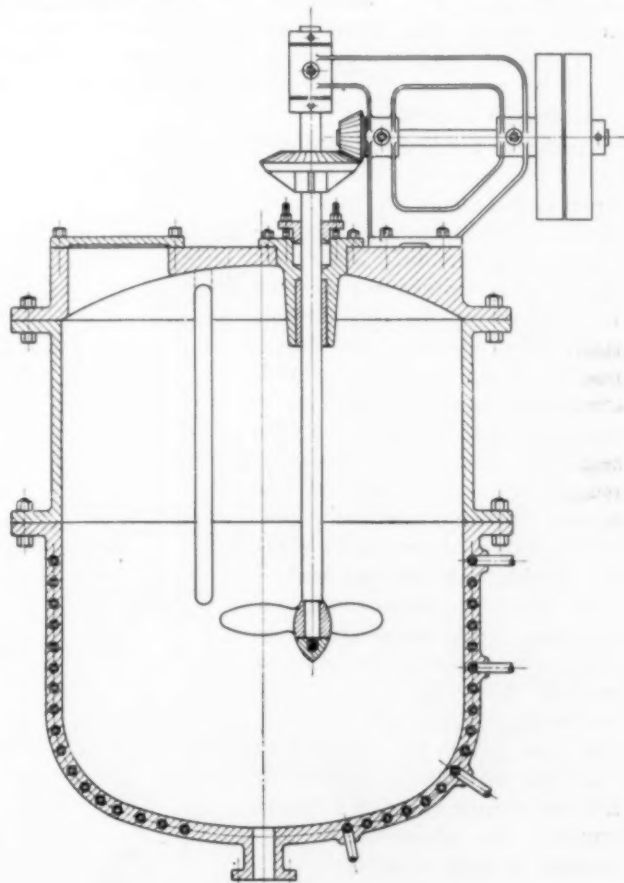


FIG. 2—SULFONATING KETTLE USING HIGH PRESSURE STEAM

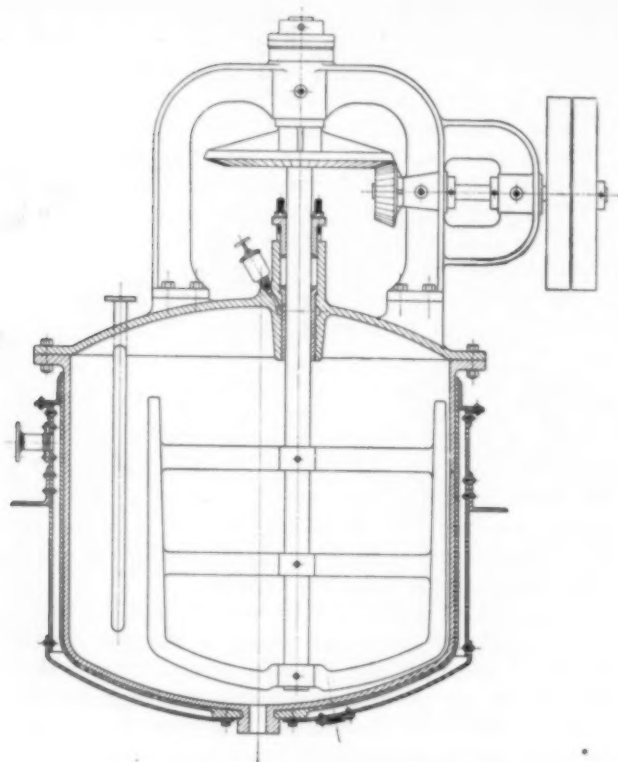


FIG. 3—ANOTHER METHOD OF USING HIGH PRESSURE STEAM

tractive method of heating if it can be worked out.

Another method of heating with high pressure steam is shown in Fig. 3. Steam at 125 lb. per square inch can be used in this jacket, the construction of which is very evident from the drawing. The jacket and inner shell are made of boiler plate, into which a lining of cast iron is poured.

Another method of getting high temperatures is to use superheated steam, the steam being at a low pressure. The objection to this method is the fact that one encounters innumerable well known mechanical difficulties. The objection to superheated steam besides the well known mechanical difficulties is the fact that the more highly steam is superheated, the nearer it approaches a gas, and the less becomes its weight per cubic foot. Both of these decrease its value as a medium of carrying heat.

A perfectly obvious way of obtaining high temperatures in a sulfonating kettle is to discard entirely the jacket and to heat the kettle directly, using preferably gas or oil for fuel, or to heat the kettle in a current of hot gas coming through a checkerwork, the checkerwork tending to give even temperatures, and to the avoiding of sudden changes up or down.

Another way is to surround the kettle with a steel jacket, forming an air bath. This method has been successfully used, but the thermal efficiency is not high.

The last method I wish to discuss for heating a kettle to a high temperature is by the use of some circulating medium, for instance, oil. In such a case we use a kettle similar to the one shown in Fig. 1, the oil entering a number of places in the bottom, and leaving through a number of openings spaced around the top. Such a system as this can easily be understood from Fig. 4 in which *a* is the sulfonating kettle, *b* the heating coil, *c* the circulating pump, *d* the expansion tank, and *e* the reflux condenser. The expansion tank should be equipped with steam heating coil to heat the oil before circulation is attempted. The first time the oil is used, the temperature should be raised gradually, as even the best circulating oil contains some water, which must be driven off before this system will work smoothly.

Temperatures up to 150 deg. C. may be maintained with the mineral oils available without serious deterioration of the oil. If it is desired to maintain a higher temperature than this, the oil circulating system should be provided with a reflux condenser to return to circulation anything that might be driven off from the circulating oil. When the system is equipped with reflux condenser, temperatures up to 250 deg. and even 300 deg. may be maintained.

A standard form of superheater re-arranged so that all the pipes are in series instead of some of them in parallel makes an excellent oil heater. The heater is preferably fired with oil or gas on account of the ease in regulation. This system should be equipped with a recording thermometer. In a well designed oil heating system, it is possible even when running a number of kettles from one heater to maintain the temperature within one or two degrees either way from a given point.

A sulfonating kettle is ordinarily equipped with a thermometer tube extending well into the liquid. It is always desirable to use a recording thermometer in connection with a sulfonating kettle.

A sulfonating kettle must always be provided with a cover to prevent loss of acid through evaporation or the weakening of the acid by abstracting water from the air. The cover may be of cast iron or boiler plate. The joint between the kettle and the cover is usually made either of lead or asbestos, although in some cases

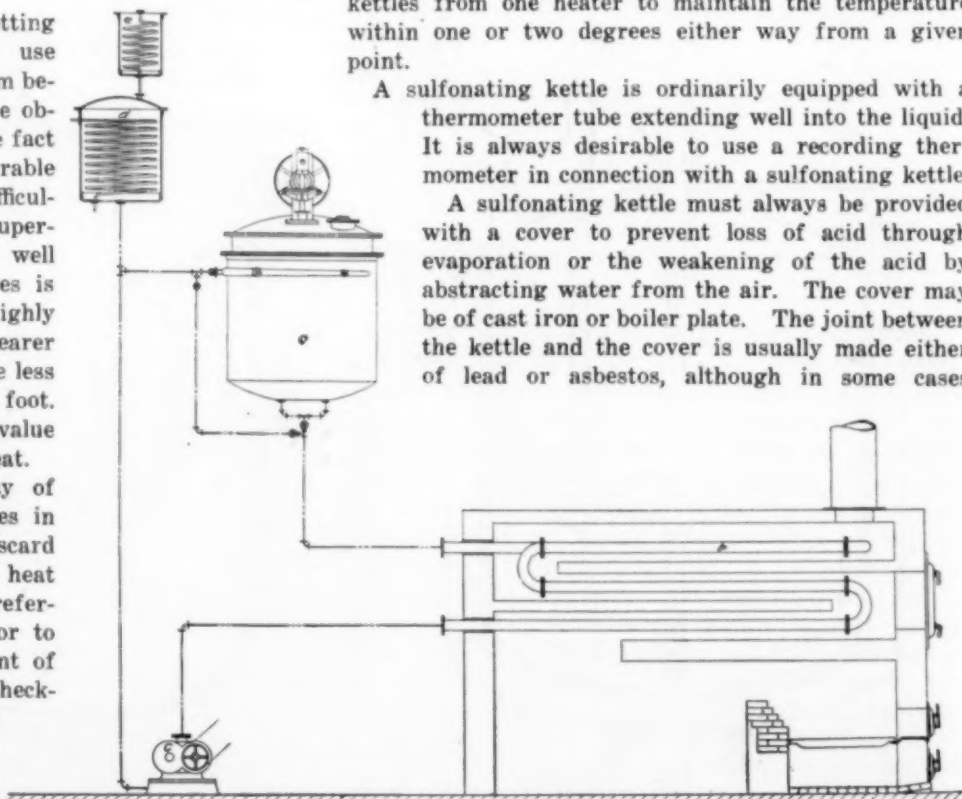


FIG. 4—OIL-HEATING SYSTEM

the cover is simply bolted to the kettle. The cover should have the following openings: A manhole as large as possible up to 12 in. by 15 in. or 14 in. to 15 in. diameter; an opening to admit sulfuric acid; in some cases a pipe connection to admit the material to be sulfonated, as for instance in a phenol plant, an opening for benzol, while in other cases, in making beta naphthol for example, the material to be sulfonated is charged through the manhole. In some instances, it is desirable to have an opening for a pressure gage or other form of manometer. If the kettle is not a bottom discharge, there is either an opening for inserting a temporary tube to the bottom or a permanent tube extending to the bottom, and an opening for compressed air for discharging the charge. It has been proposed to discharge the kettle through a hollow agitator shaft, but this is not recommended. There may be necessary an opening for the escape of fumes or for a condenser.

In the case of many reactions, often in the sulfonation of amino compounds, the reaction mass must be cooled in order to prevent undesired sulfonation of the compound. This cooling may be accomplished by either introducing water into the jacket if possible, or by having closed end pipes of enameled or acid resisting iron extending into the mass, and running cooling water or brine through these pipes.

The apparatus must be designed to meet the requirements of the reagent used. Ordinary pig iron, which is generally used, is not used with fuming acid, since it is quickly corroded by the high temperatures, which are often maintained for hours, in such a way that they accumulate gas in the little hollow spaces of the iron (hydrogen, carbon dioxide, etc.) which may disinte-

grate the cast iron. Wrought iron is strongly corroded by fuming acid up to 25 per cent free  $\text{SO}_3$ , at which strength it is again passive.

Various linings may be used. Enamel or lead applied directly to the inside of the kettle, or a chemise of nickel are used. The advantage of a nickel chemise is that when it is used up, it may be withdrawn and replaced by a new one.

Kettles have been built with horizontal stirring devices, but this is not desirable because of the difficulty in keeping the stuffing boxes tight when the shaft is in a bearing in contact with acids. It is also true that a horizontal stirring apparatus requires more power than a vertical one. A slanting stirring device gives uniformly good results, but for some undetermined reason is seldom used. The writer recommends it to the earnest consideration of users of sulfonating kettles.

Nearly all sulfonating kettles are provided with agitators of which there are a number of forms in use. The ordinary "U" type of agitator with the center line of the shaft coinciding with the center line of the kettle as shown in Fig. 3 is a common type, and for many uses very successful. This type of agitator is also used with the center line of the shaft parallel to the center line of the kettle, but a little off center, which gives a better agitation.

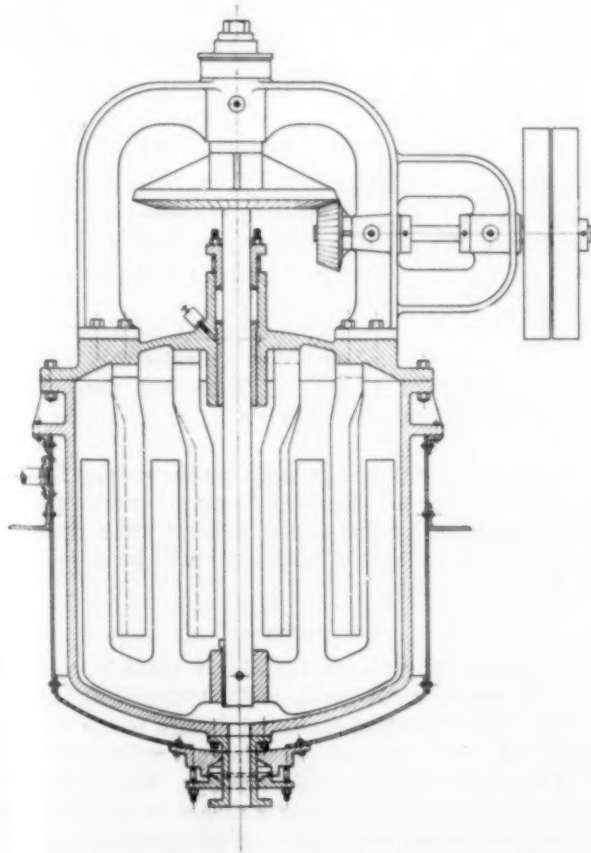


FIG. 5—KETTLE WITH SPECIAL TYPE OF AGITATOR

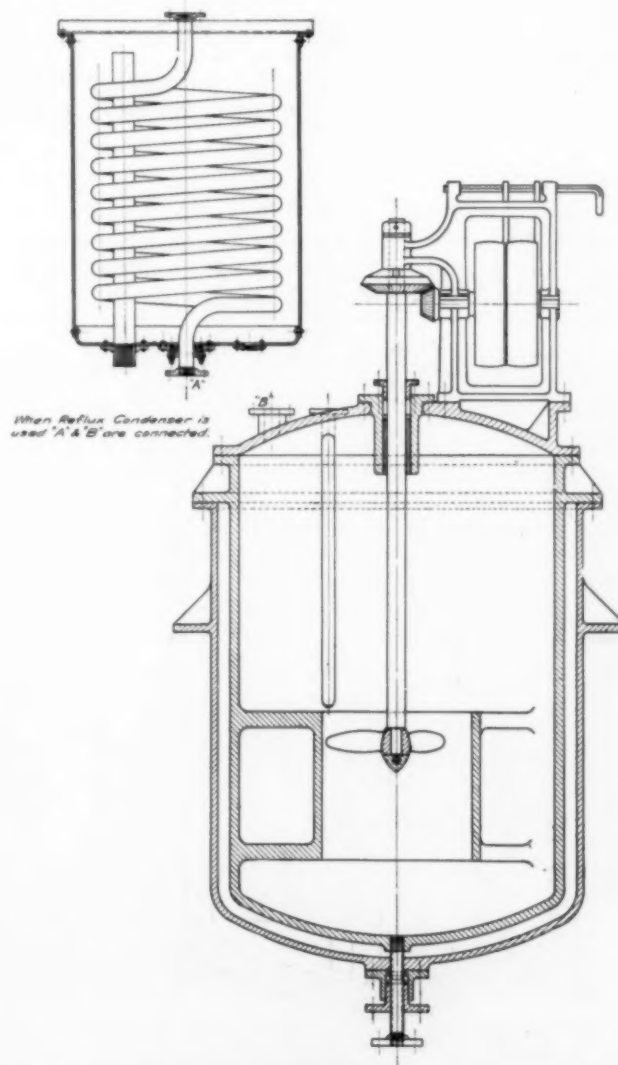


FIG. 6—KETTLE WITH PROPELLER ENCLOSED IN TUNNEL

Another type of agitator which is very useful for certain purposes is shown in Fig. 5, which is really an elaboration of the "U" type. It is really a number of "U" type agitators with breakers.

The propeller is largely used as an agitator in a number of different ways, and although it is undoubtedly the ideal agitator under certain conditions, it cannot be used indiscriminately. There is one correct speed for the propeller type of agitator, which depends upon the size and shape of the kettle, size, form and pitch of the propeller, and the liquid in the kettle. A comparatively small variation from this speed will reduce greatly the efficiency of the agitating device. It follows that the propeller type is usually unsuitable in a sulfonating kettle in which the character of the liquid changes in the course of the reaction.

A single propeller is often used. A modification of this, considered by some to be an improvement, is to inclose the propeller in a tunnel, as shown in Fig. 6.

Another arrangement favored by many is two propellers on the same shaft, one propeller throwing in one direction, and the other in the other. Often these propellers have varying pitches. An arrangement of this sort well thought of in England has two propellers working in different directions with different pitches, with side breakers on the inside of the kettle, the shaft carrying the propellers revolving rapidly (250 r.p.m.). This is shown in Fig. 7. In certain work, it is reported to have been very successful.

In the opinion of the writer the best arrangement of the propeller is either one or two propellers; in case

two are used, with varying pitches, and throwing in opposite directions, the shaft carrying the propeller or propellers parallel with the center line of the kettle, but a certain distance off center, as shown in Fig. 2.

There are a number of special types of agitators for particular service used in sulfonating kettles. For instance, there are kettles built in which the shaft carrying one agitator is hollow, another shaft extending through the hole in the shaft carries another agitator revolving in the opposite direction. There are scraper types of agitators for particular purposes. In fact, the desirable type of agitator must be chosen in each case, and can only be determined by experience and study.

In a bottom discharge kettle, the design of the bottom discharge must be carefully considered. Many makers design a sulfonating kettle in which the discharge pipe passes through a stuffing box in the outer jacket and is screwed into the sulfonating kettle. For some uses, this construction is applicable, but often the screw threads are attacked by the acid, the threads in the casting being attacked as well as the threads in the discharge pipe. When the threads in the kettle have been destroyed, troublesome repairs are necessary. It is much better to introduce a spool piece between the kettle and the jacket as shown in Fig. 5. The valve controlling the discharge can be bolted directly to this spool piece.

Another method is to make the discharge pipe of cast iron with a flange cast on either end. The discharge pipe is bolted to the sulfonating kettle, passing through the jacket through a stuffing box. In this case it is necessary that the stuffing box and gland be split.

There has been considerable interest of late in continuous sulfonation, a number of schemes having been devised for the purpose. A step in this direction is sulfonation in two stages, which has been very successful in at least one large works.

Moses, Pope & Messer, Inc.  
New York City.

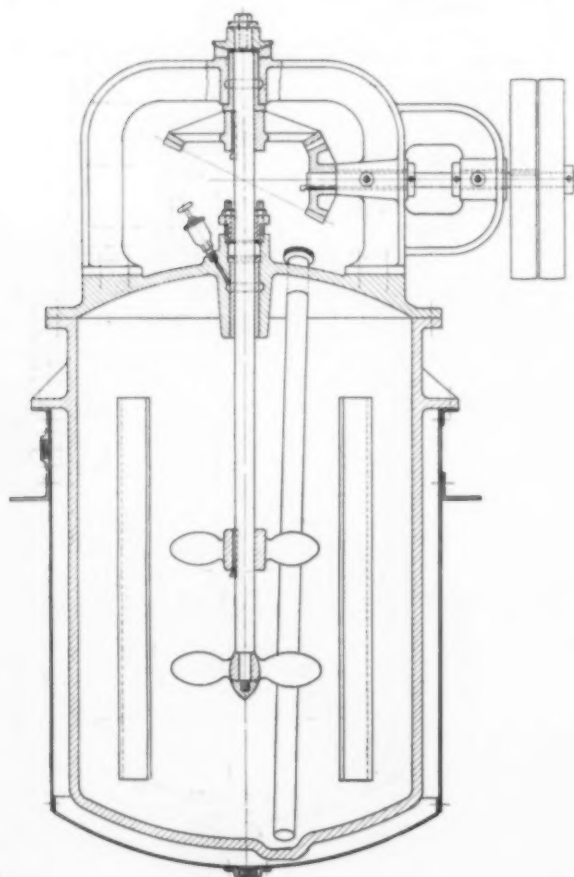


FIG. 7—KETTLE WITH TWO PROPELLERS ON THE SAME SHAFT

**Washington School of Mines.**—The School of Mines was given an important place in the reorganization of Washington State College, at Pullman, Wash., by the board of regents at its last meeting and recently announced by President E. O. Holland.

Under the new plan, the mining end becomes one of the eight schools or colleges that comprise this state institution, and Prof. Francis A. Thompson, head of the mining department, becomes dean of the school of mines.

Full facilities will be available for instruction in, and treating ores by, all standard forms of treatment, including leaching, amalgamation, concentration, roasting and smelting. A special laboratory will be devoted to the flotation process.

**Endowment of research** on a large scale is the form that the memorial to the late Sir William Ramsay is to take. Five hundred thousand dollars is the amount mentioned. The interest on this sum will be devoted to the establishment of fellowships, which will be granted to mature investigators rather than to budding students. Ramsay was the most energetic and daring chemist that England has produced, and he deserves a substantial and generous monument in his remembrance.

## Suggested Improvements in the Manufacture of Silica Brick\*

By C. E. Nesbitt and M. L. Bell

The study of silica refractories is receiving more and more attention as shown by the increased number of articles appearing in the technical magazines. The published literature so far has dealt mainly with the theoretical study of the raw materials, while the practical side has received very little attention. Theoretical information is of extreme importance, but its importance is negative until put to practical use. The brick manufacturer is not as a rule a man of theoretical training, hence theoretical investigations to be of use to him must be expressed in simple and explicit terms, easily understood. This does not however excuse the maker, who in most cases has been negligent in regard to investigations of the properties and to improvement of his own product. The consumer has also been at fault in that he has not freely co-operated with the maker and informed him wherein the bricks failed. To obtain the best result it is necessary that these three—the investigator, the maker and the consumer—should work together with heartiest co-operation.

In the manufacture of iron and steel, silica brick find their greatest use in the open-hearth furnace. The demand here is for a brick of high refractoriness which does not become soft or plastic at working temperatures. The silica brick fulfills these requirements in that it is refractory and does not yield to compression unless the stress is sufficient to crush it. The ability of silica brick to stand when only a small portion of the original wall is left is well illustrated in the bulkheads. (Fig. 1.) This wall when built is 18 in. thick, but wears away in spots to less than 1 in. in thickness and still the brick retains its place.

In the by-product coke industry the development of the use of silica brick is interesting. Formerly a quartzite brick was used which was made of a mixture of clay and ganister. The object of the quartzite brick was to overcome the shrinkage and settling common to fire brick. Some twelve years ago silica brick were used experimentally in both beehive and by-product ovens. The experiment proved so successful that their use increased rapidly; not only did their expansion make a close, well-fitting joint and overcome settling difficulties, but their better heat conductivity greatly reduced the coking time. (Fig. 2.)

### THE MANUFACTURE OF SILICA BRICK

In the manufacture of silica brick in this country the raw material used is quartzite rock commonly known as ganister. The important deposits are found in Huntingdon and Blair Counties of Pennsylvania, Devil's Lake region of Wisconsin, and in Alabama and Colorado. It is essential for high-grade silica brick that the ganister be hard and dense. The rock should analyze about 98 per cent silica, with 1 per cent each of iron and alumina. The raw material is broken to convenient size, dumped into a wet pan, and ground with water and lime. The degree of fineness and

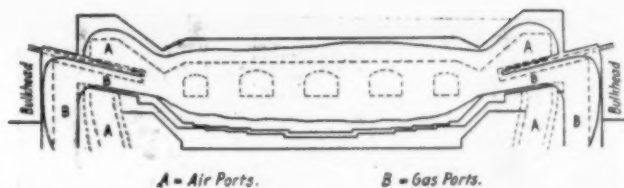


FIG. 1—VERTICAL LINES OF EROSION ON AN OPEN-HEARTH FURNACE

the amount of water is left to the judgment of the operator. This is a source of considerable variation, as it will be shown later that the degree of fineness has considerable influence on the strength of the finished brick.

The binder commonly used is lime. Two per cent has been found to give the most satisfactory results. Percentages greater than this lower the refractoriness and decrease the strength of the brick, while percentages below 1½ per cent do not give a satisfactory bond. Binders such as iron, alumina, talc, water glass and other substances have been tried with more or less success.

The amount of water necessary to produce a satisfactorily working mud varies somewhat with the kind of rock used, amount of calcined material present and the method of manufacture. The percentage of moisture present is important. About 10 per cent of available moisture is the proper amount for hand-made brick. Too wet a mud will produce bricks and shapes which distort after being taken from the mold, while too dry a mud is responsible for a number of very serious defects, such as unfilled corners, sponginess, improper slicking, and lack of cohesion, all of which tend to give a finished product of low mechanical strength, susceptible to spall and slag penetration. (Figs. 3 and 4.)

The molding is a very critical point in the manufac-

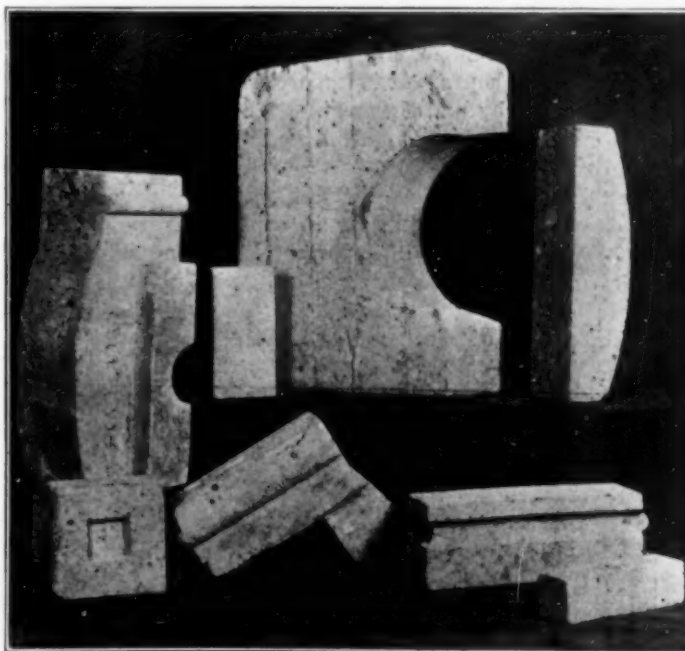


FIG. 2—A FEW DIFFICULT BY-PRODUCT COKE-OVEN SHAPES, ILLUSTRATING SHRINKAGE CRACKS AND CRACKS DUE TO RE-ENTRANT ANGLES—NOTE 9-IN. BRICK IN CENTER FOR RELATIVE SIZE

\*A paper presented at the Atlantic City Meeting of the American Society for Testing Materials, June, 1917.

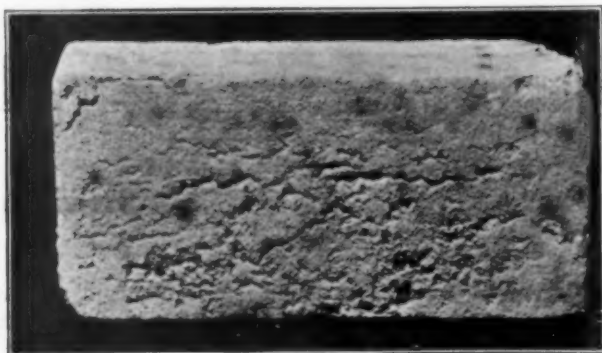


FIG. 3—AN EXAMPLE OF BAD MOLDING, POOR SLICKING, AND SPONGINESS

ture of silica brick. Improper filling of the molds, too wet or too dry mud, improper slicking, dirty palette boards, or careless handling, all contribute their share to the making of a defective product. The defects can largely be eliminated by close inspection and rejection of all but good bricks. As an illustration, bricks were received from a certain company which were poor in quality. The spalling loss was very high, running from 50 to 60 per cent. An investigation was made of the methods at the plant and irregularities of mixing, molding and burning were found. Careful inspection was applied to certain points in the brick manufacture, and to-day this same plant, with no radical change in its general method, is producing bricks much more uniform in shape, strength and appearance, and with a spalling loss of only 25 per cent.

Drying of the brick after molding is accomplished either on a hot floor, heated by steam, or in tunnels heated by hot air from the kilns. Drying on the floor is naturally the slower of the two methods, four to six days being required for 9-in. brick and proportionally longer for larger shapes, while drying in tunnels may be accomplished in eighteen to twenty-four hours. It is important that drying shall be done carefully and thoroughly, for unless the material is bone dry when placed in the kilns fire cracks are apt to result. (Fig. 5.)

The dried brick are set in kilns, which are usually of the down-draft type ranging in capacity from 50,000 to 150,000 bricks. It is important in setting that the bricks shall be true to shape in order that they have a proper bearing and stack well. Green bricks will not sustain a load of much more than 100 lb. per square

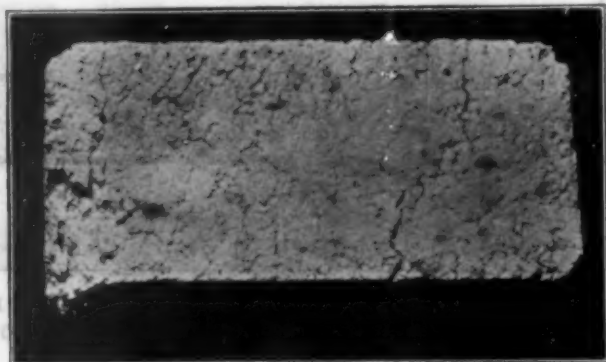


FIG. 4—AN EXAMPLE OF BAD MOLDING AND FIRE CRACKING

inch, hence care should be taken not to overload them. Shapes should not be placed near fire boxes nor bear much weight. They are frequently boxed in.

Complete burning requires from ten to fifteen days, with a gradual increase in temperature until cone 16 is attained at least, (1450 deg. C.). The final temperature must be held a sufficient length of time to thoroughly and uniformly heat the entire kiln, which may require anywhere from one to three days, depending on the size of the kiln.

The cooling usually requires about five days and is accomplished by gradually opening the fire holes and doors until the bricks are cool, when they are removed and placed directly on cars or in the stock house.

#### TESTS OF SILICA BRICK

With a view to studying the effect of degree of fineness of material and pressure, an experimental series of silica brick was made with these two factors as the only variables. A good quality of Pennsylvania gansister was selected and ground dry in three lots to pass a 12, 8 and 4-mesh screen respectively. To the ground material was then added the water and lime so as to give 9 per cent of moisture and 2 per cent of lime. From each of the above meshes standard 9-in. bricks

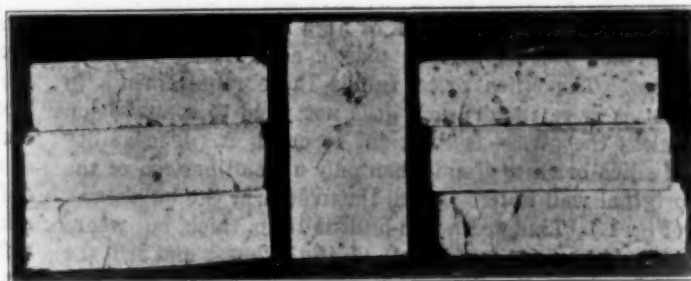


FIG. 5—CHARACTERISTIC FIRE CRACKS

were made on a small hydraulic press at eight different pressures varying from 187 to 2500 lb. per square inch. The bricks were dried, burned and cooled, following regular silica-brick practice, and were then subjected to certain physical tests to determine density, resistance to impact, resistance to spall, resistance to corrosive action of slag and expansion due to heating. A summary of the results is given in Table I, in which the results of the three meshes are averaged according to pressure.

TABLE I—TESTS OF SILICA BRICK, ARRANGED ACCORDING TO PRESSURES

Pressure Under which Bricks were Made, Lb. per Sq. In.	Apparent Specific Gravity	Impact, In.	Percentage Spalled	SLAG PENETRATION, Sq. In.		Expansion, Lin. In. per Ft.
				Open-Hearth Slag	Heating-Furnace Slag	
187	1.50	47	45.5	3.48	2.28	0.155
500	1.58	46	48.3	3.68	2.42	0.155
750	1.59	60	53.2	3.63	2.41	0.158
1000	1.63	65	51.4	3.79	2.42	0.160
1250	1.65	68	47.9	3.65	2.50	0.155
1500	1.66	65	43.6	3.82	2.50	0.160
2000	1.67	67	44.8	3.64	2.45	0.159
2500	1.68	71	42.0	3.72	2.50	0.160

Table II shows the results of the various pressures averaged according to mesh.

<sup>2</sup>The methods used are described in detail in this issue, page 184.

TABLE II—TESTS OF SILICA BRICK, ARRANGED ACCORDING TO MESH

Mesh	Apparent Specific Gravity	Impact, In.	Percentage Spalled	SLAG PENETRATION, Sq. In.		Expansion Lin. In. per Ft.
				Open-Hearth Slag	Heating-Furnace Slag	
4	1.66	57	30.4	3.92	2.63	0.156
8	1.62	63	47.6	3.67	2.39	0.159
12	1.58	64	63.2	3.44	2.29	0.159

Table I indicates that little is gained by increasing the pressure. Table II, however, shows the importance of the selection of mesh. It will be observed that the strength as indicated by the impact test is greatest with the fine-ground material, while the percentage loss by spalling increases with fineness of mesh. Two very important properties in first-class silica brick are the mechanical strength and resistance to spalling; hence from the data we must select a mesh at the expense of one of these properties. More is gained by the coarse mesh, hence we advocate for silica brick a coarse-ground material. (Fig. 6.)

Table III gives the individual losses by spalling for each pressure and mesh.

TABLE III—LOSSES BY SPALLING, EXPRESSED AS PERCENTAGE

Mesh	PRESSURE UNDER WHICH BRICKS WERE MADE, LB. PER SQ. IN.							
	187	500	750	1000	1250	1500	2000	2500
4	21.9	34.9	37.9	38.7	31.4	30.4	19.1	29.1
12	51.6	45.9	62.6	51.0	43.3	34.8	38.3	43.3
	62.9	64.0	59.2	64.4	69.1	65.8	67.0	53.6

well molded, true to shape, thoroughly bonded, and of good mechanical strength. (Fig. 8.)

A visual inspection of almost any shipment will show at least 20 per cent of defective brick. Six shipments of brick of different brands brought out the fact that 60 per cent of the defects were due to molding, 30 per cent to fire cracks, and 10 per cent to improper setting and irregular shapes. These defects can be largely overcome in the present method of manufacture by careful inspection and rejection of the improperly made bricks at certain points in the manufacture.

The ganister must be carefully selected and sorted; all stock that is soft or which carries considerable iron, clay, sandstone or other foreign matter should be rejected. (Fig. 9.) The ganister selected should be



FIG. 6—SPALLING TEST ON EXPERIMENTAL SERIES—NOTE BRICKS IN ILLUSTRATION ARE AVERAGED WITH PRESSURE INCREASING FROM LEFT TO RIGHT AND MESH INCREASING FROM FRONT TO BACK. (TABLES I AND II ARE ARRANGED IN CORRESPONDING ORDER)

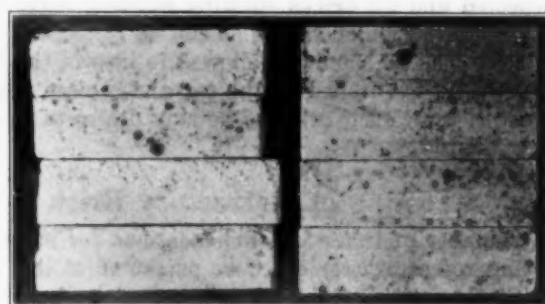


FIG. 7—COMPARISON OF HAND-MADE AND COMMERCIAL POWER-MADE BRICKS  
NOTE JOINTS

The average spalling loss for hand-made silica brick is about 30 per cent. From Table III it will be noted that power-pressed silica brick were made with the same spalling loss from 4-mesh material pressed at 1500 lb. per square inch. These bricks were true to shape, sharp-cornered, dense, and had smooth, marble-like surfaces. Molding defects such as soft corners, sponginess, improper slicking, and lack of cohesion were all eliminated. The prospect of the adoption of power pressing as a step towards better and more uniform silica brick was clearly brought out by this series of tests. The idea of power pressing is not entirely new, yet little has been done in a commercial way. One of the large concerns is now manufacturing brick this way on a commercial basis. The average spalling loss of these bricks is 25 per cent. (Fig. 7.)

In actual service, although well guarded as far as practice and construction will permit, silica brick fail from three primary causes: spalling, crushing and slagging. These cannot be entirely eliminated, but by a deeper study of the manufacturing of brick they can be reduced to a minimum. An ideal brick must be

ground to just pass a 4-mesh screen, care being taken to avoid an excessive amount of finely ground material. To insure uniformity, frequent sieve tests of the mud should be made. To secure a sufficient bond, 1.75 to 2 per cent of lime should be used. In order to avoid irregular

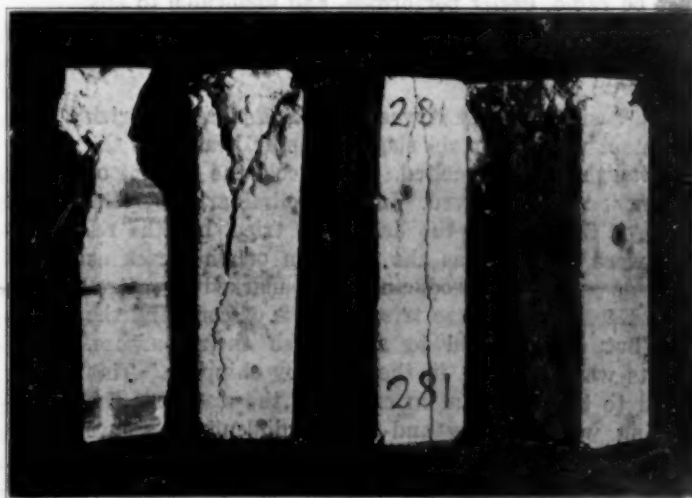


FIG. 8—CHARACTERISTIC CRUSHING TESTS

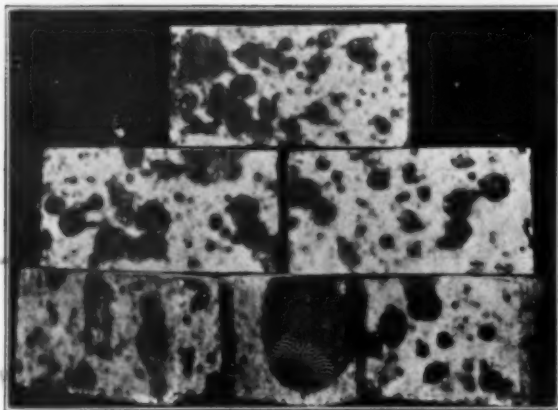


FIG. 9—DEFECTS DUE TO IRON IN RAW MATERIALS

shapes and molding defects, 9 to 11 per cent of water should be used for hand-made bricks and the material should be pounded into the mold. The bricks should be thoroughly dried so as to avoid fire cracks when placed in the kiln. Great care should be used when heating, especially during the first part of the burn, to prevent fire cracking; this applies also to the cooling. The bricks as they are removed from the kiln should be carefully inspected and all bricks showing molding defects, fire cracks and irregular shapes should be rejected.

The consumer should be allowed to inspect the bricks before they are loaded on the car and a place provided for storage of such brick as he may desire to test.

### Testing of Refractory Brick

A number of timely recommendations for practice in testing refractory cement were presented at the Atlantic City meeting of the American Society for Testing Materials during June, 1917. These interesting papers and tentative tests are as follows:

#### Slag Test for Refractory Brick

Early in the study of the physical properties of refractory material in the iron and steel industry, the necessity for a slag test which would give information as to the relative resistance of refractory brick to various slags and fluxes became apparent. To be of use in specifications it was evident that such a test must be rapid, easily performed, and applicable to any kind of brick or slag, and should as far as possible approach conditions similar to those under which the brick is to be used.

As a basis for a test it was decided to place the brick in contact with a certain slag and apply heat until the slag was thoroughly melted. When cold the amount of penetration was observed. In the preliminary work the piling of the slag on the brick was tried, but the results were negative, as the slag ran off the brick as soon as melted, producing no marked penetration. Kaolin rings were tried in hope of confining the slag, but these failed to accomplish their purpose. Pockets were next cut in the brick by chipping. This proved to be successful in confining the slag, but the chipping was too slow and it was difficult to secure uniform cavities. Drilling by means of a press was next resorted to, and uniform pockets were drilled as near as the nature of brick material would permit.

A recommended procedure is as follows: The drill used should be 5/16 in. in diameter, the point should be tapered to include an angle of 150 deg., and the width of the bit should be such as to cut a hole 2 1/2 in. in diameter. Drill a hole 1/2 in. deep on the sides. The cavity after drilling should be checked up by a standard template, and should conform to the same as nearly as the nature of the material permits. All loose material, dust and cuttings should be carefully removed from each cavity.

The bricks were then heated to testing temperature (1350 deg. C.) and a known quantity of slag was placed in the drilled cavities. After the bricks had become cold they were broken through the slag cavity and examined. Visual examination proved of small value, as results could not be accurately compared; hence it was found necessary to devise some means by which the amount of penetration could be measured. This was accomplished by sawing the brick so that one of the sawed faces accurately bisected the center of the original cavity, and the area of slag penetration thus exposed was then measured by means of a planimeter. The wheel used for sawing the brick is a carborundum wheel, 12 in. in diameter, 3/8 in. thick, 1 1/2 in. diameter of center hole, grit 16, bond NCH, known as a vulcanite wheel.

To standardize the method it became necessary to determine whether the fineness of the slag, the time to which the slag was exposed to the brick, and the amount of slag used in the test had any effect upon the amount of penetration.

To determine the effect of fineness of the slag on the amount of penetration, blast-furnace and heating-furnace slags were selected as representative of the iron and steel industry. Each was ground and separated into two sizes, coarse and fine. The coarse material was that which passed a 40-mesh and remained on a 60-mesh sieve, while the fine was represented by that which passed through a 100-mesh sieve. The slag test was then run in the usual manner on standard hearth and bosh blast-furnace brick. The average results were as follows:

	Penetration, sq. in.
Blast-furnace slag... { 40 to 60-mesh.. 1.54	
	100-mesh.. 1.67
Heating-furnace slag. { 40 to 60-mesh.. 1.77	
	100-mesh.. 1.72

From the above results it seems that the degree of fineness of the slag does not affect the penetration.

To determine whether the time to which the slag was exposed to the brick, and also whether the amount of slag used in the test affected the penetration, a series of slag tests were run, in which the slag was exposed to the brick at testing temperature for two, four and six hours, with the quantity of slag varying from 35 to 140 g. The results of slag penetration are given in Table I.

From Table I it is shown that the amount of penetration is not increased by keeping the brick in contact with the slag for a longer period than two hours. Preliminary work had shown that one hour would in most cases give complete penetration, so that the adoption of two hours was considered sufficient.

<sup>1</sup>From a paper by C. E. Nesbitt and M. L. Bell and proposed tentative tests by the Committee on Refractories.

TABLE I—PENETRATION OF SLAG FOR VARIOUS TIMES OF EXPOSURE AND AMOUNTS OF SLAG

Time of Exposure, Hours	PENETRATION FOR—GRAMS OF SLAG USED, Sq. In.			
	35	70	105	140
2	0.49	0.58		
4	0.51		0.79	
6	0.45			0.79
8	0.51	0.58		
10	0.43		0.78	
12	0.43			0.83
14	0.46	0.52		
16	0.44		0.70	
18	0.52			0.89
Average	0.45	0.56	0.76	0.84
Area exposed to slag action, sq. in.	5.94	7.97	8.57	9.44
Ratio of exposed area to standard cavity	1.00	1.34	1.44	1.59
Average slag penetration divided by ratio	0.45	0.42	0.53	0.53

It will also be noted that there are two variables, namely, the amount of slag used and the area exposed to slag action. To make the average results comparable these variables must be eliminated. This was accomplished by reducing the area exposed to slag action to a unit figure by dividing the area of the standard cavity (5.94 sq. in.) into each of the other areas (columns 3, 4 and 5 in Table I). The ratio figures thus obtained were divided into the average slag penetration and the results (slag penetration divided by ratio) made comparable. These figures prove that increasing the amount of slag does not affect the slag penetration, when reduced to a unit of area exposed to slag action. The variation in the results are within checking limits and the difference due to the variation in the bricks

themselves. For routine work it is recommended that 35 grams of powdered slag (through 40-mesh) should be introduced into the drilled cavity after the brick has been heated to 1350 deg. C., held at that temperature for two hours, and cooled in the furnace.

The question of the advisability of performing a slag test in a drilled pocket as compared to immersing the brick in molten slag was next studied. Bricks from the same shipment were tested, one-half of them by the drilled-pocket method in the usual way, while the others were placed on edge in a refractory tray or shallow box,

TABLE II—RESULTS OF SLAG PENETRATION

Sample	Area No.	IMMERSION METHOD			DRILLED-POCKET METHOD		
		Slag Penetration, Sq. In.	Slag Contact of Brick, Linear In.	Slag Penetration per Linear Inch of Contact	Slag Penetration, Sq. In.	Slag Contact of Brick, Linear In.	Slag Penetration per Linear Inch of Contact
A	1	5.50	7.0	0.78	1.67	3.5	0.48
	2	1.68	7.0	0.24	1.48	3.5	0.42
	3	2.50	7.0	0.36			
B	1	4.96	8.5	0.58	1.10	3.5	0.31
	2	4.82	8.5	0.55	1.06	3.5	0.30
C	1	0.91	10.0	0.09	0.88	3.5	0.25
	2	0.57	10.0	0.10	0.71	3.5	0.20

in which slag was placed to a depth of 1½ in. All were heated at a uniform rate to 1350 deg. C. and held for one hour. After cooling the bricks were cut at right angles to their length into two or three sections, the cuts being about 1 in. apart. The drilled-pocket samples were cut in the usual way, a second cut being

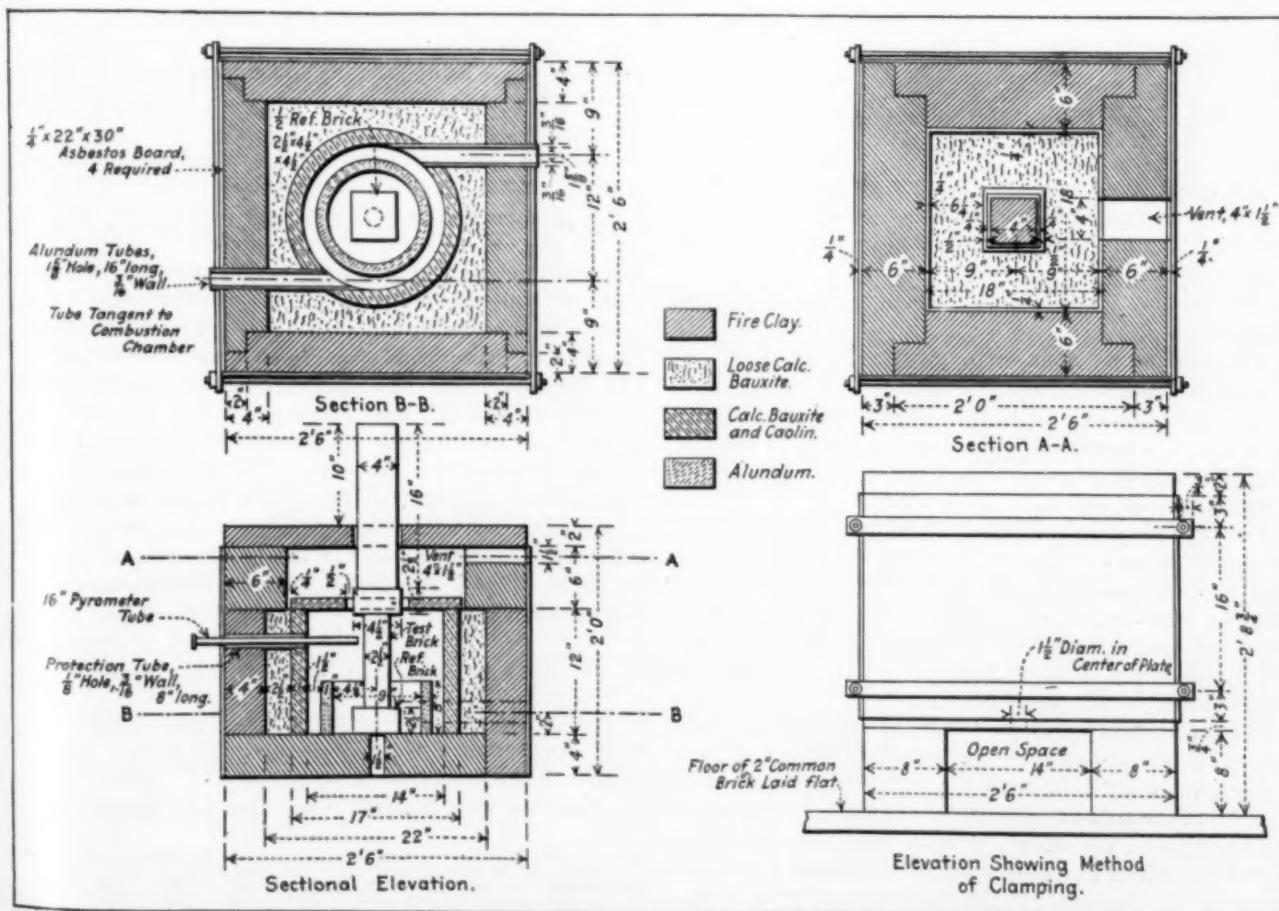


FIG. 1—APPARATUS FOR TESTING REFRACTORY MATERIALS UNDER LOAD AT HIGH TEMPERATURES

then made at right angles to the first. The areas of slag penetration thus exposed were measured with a planimeter; also, the linear inches of slag contact on the surface of the brick were measured. Heating furnace slag was used in this test. Table II gives the results of these tests.

From the results it is evident that greater uniformity of results is obtained by use of the drilled pocket than by immersion. The drilling of pockets to contain the slag is also preferable to the use of large trays to contain the slag, because of economy of space in the furnace.

The drilled-pocket method as at present adopted has several points which recommend it as a standard method. It is very flexible, as cavities, slags, temperature and the amount of slag can be easily changed to correspond to the service conditions under which the bricks are to be used. It is rapid, easily performed, and results are expressed by a definite numerical quantity.

When clay bricks for blast-furnace or similar uses are to be tested, blast-furnace and heating-furnace slags are used. Silica bricks for open-hearth use are tested with open-hearth and heating-furnace slags. The slags used in the development of this test were selected as representing the iron and steel industry and were of the following chemical composition:

	Blast-Furnace Slag	Heating-Furnace Slag	Open-Hearth Slag
Silica (SiO <sub>2</sub> ), per cent.	38.0	35.0	18.4
Iron (Fe), per cent.	1.5	44.0	14.5
Manganese (Mn), per cent.	1.0	0.5	5.1
Alumina (Al <sub>2</sub> O <sub>3</sub> ), per cent.	14.5	6.0	3.8
Lime (CaO), per cent.	42.0	1.5	44.1
Magnesia (MgO), per cent.	2.0	0.5	6.3
Sulfur (S), per cent.	1.0	...	0.4

### Refractory Materials Under Load At High Temperatures\*

The apparatus for testing refractory materials under load at high-temperatures consists essentially of a furnace and loading device, constructed in accordance with Figs. 1 and 2.

The furnace is cylindrical in form, 14 in. in internal diameter.

The heating is done with gaseous or oil fuel and compressed air, using not less than two burners located tangentially and so arranged that no flame can impinge upon the test specimen. The burners must be such as will insure a uniform temperature in all parts of the furnace and be under complete control.

The details of the method of loading shown in Fig. 2 should be such as will insure accuracy in the applied load and freedom from eccentric loading, both in the original application and during the testing. It is advantageous to make the cross-beams as light as possible, so that the greater portion of the load may be concentrated in the weights.

The temperature may be measured either with a calibrated platinum-rhodium thermocouple, encased in a double protecting tube with the junction not more than 1 in. from the side or edge of the specimen and approximately opposite the center; or with some form of optical pyrometer which has been calibrated against a thermocouple in the furnace. If the thermocouple is used, the

\*From tentative tests submitted by Committee on Refractories, A. V. Bleininger, Chairman.

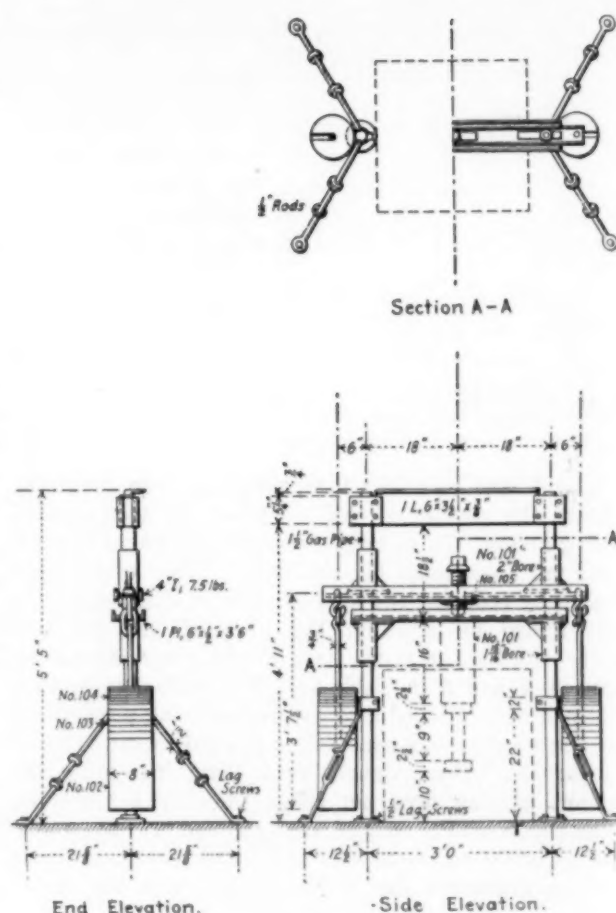


FIG. 2—METHOD OF LOADING

cold-end temperature should be kept constant in melted ice. A recording form of indicator is recommended where possible.

The test specimen consists of a standard 9-in. brick placed vertically on end. In the case of blocks or shapes cut a piece approximately 9 by 4½ by 2½ in., utilizing as far as possible existing plane surfaces. The ends of the specimen should be either ground so that they are parallel and perpendicular to the vertical axis, or if this is impossible should be bedded in a neutral cement, so that the specimen is perpendicular to the base of the furnace. The test specimen should be measured before testing to within ±0.02 in.

The test specimen occupies approximately the center of the furnace and rests on a block of some highly refractory material, having a minimum expansion or contraction. A silicon-carbide brick has been found satisfactory. At the top of the test specimen a block of similar highly refractory material is placed, extending through the furnace top to receive the load.

TABLE III—TEMPERATURES FOR HEATING AT VARIOUS PERIODS

Material	TEMPERATURES, IN DEG. CENT., TO BE MAINTAINED AT THE TIME INTERVALS SPECIFIED					
	1 Hr.	2 Hr.	3 Hr.	4 Hr.	4½ Hr.	6 Hr. (End of Test)
Silica material	200	500	900	1350	1500	1500
(Heavy duty)	500	900	1150	1300	1350	1350
Fire clay	500	850	1100	1250	1300	1300
(Light duty)	500	750	950	1050	1100	1100

The method of heating should be in accordance with Table III, which gives the rate and time of heating suggested for different grades of material.

It is recommended that for general purposes a load of 25 lb. per square inch be used. The additional masses required to give the desired loading should be equally distributed on each side of the beam.

At the expiration of six hours the furnace is allowed to cool during a period not less than five hours, before removing the load and examining the test specimen. After the test specimen has cooled to the room temperature, it is remeasured as before, and the change in length recorded and reported as percentage of the original length.

It is recommended that a photograph be made of the specimen before and after testing as yielding valuable information at a minimum time and expense.

### Crushing Test<sup>2</sup>

The apparatus may be any of the standard testing machines such as the Olsen, Riehle, or others.

*Operation of Test.*—The brick to be tested is first carefully inspected and, if necessary, ground on a carborundum wheel so that both ends are parallel. The brick is then measured, placed in a cold furnace and heated at a uniform rate from atmospheric temperature to 1350 deg. C. (The heating as a convenience is done over night at a uniform rate, not exceeding 260 deg. C. per hour. The total time of heating should in no case be less than six hours.) The final temperature of 1350 deg. C. is maintained for not less than two hours. The brick is then quickly removed from the furnace and placed on end in position on the testing machine. To insure good bearing a thin piece of asbestos board is placed above and below the brick. The machine is started and operated until the brick is crushed. The crushing strength is recorded in pounds per square inch.

### A Short History of the Detinning Industry\*

The Goldschmidt Detinning Company is the largest concern of the kind in the United States and one of the largest in the world, detinning in excess of 100,000 tons of tin scrap per year and information on the company and its work should prove very interesting.

The tin plate, as practically everybody knows, is really a sheet iron plate coated with tin, the object being to combine the strength of the iron with the rust resisting quality of the tin. The art of covering sheet iron with a thin coating of tin dates back many generations. In fact, as early as the middle ages this art was practiced in the Bohemian Mountains. Later, during the early part of the 17th century the industry spread to Saxony, and about 100 years later it was introduced into Wales, where, in the course of time, it developed into the great tin plate industry which, since the beginning of the 19th century, has grown to be one of the most important branches of British commerce. The production of tin plate in England before the war was about 700,000 tons per year.

<sup>2</sup>From an appendix to a paper on Improvements in the Manufacture of Silica Brick, by C. E. Nesbitt and M. L. Bell. Other tests for refractory fire-brick have been developed by the same authors, such as impact, spalling, expansion, size and abrasion, which have already been published in *Metallurgical and Chemical Engineering*, Vol. XV, page 208 (August 15, 1916).

\*From *Reactions*, second quarter, 1917.

This Welsh tin plate industry absolutely controlled the market of the world up to about 1890, and it is rather interesting to know that about 70 per cent of the production was sold to the United States. Since the McKinley act of 1890, however, which placed a high protective tariff on tin plate, it became possible to establish the industry in this country, and it has developed so rapidly that it is larger by far to-day than is the old-established industry of Wales. Before the outbreak of the war over 1,000,000 tons of tin plate was produced per year in the United States, and at the present time the production is estimated at about 1,300,000 tons. It thus appears that tin plate is one of the great staple articles of the world.

Naturally, as the tin plate industry grew to large proportions, the question was raised as to what could be done with the clippings and other scrap which accrue and which accumulate in large quantities. In fact, this problem was considered as far back as the middle of the 19th century, and efforts were made to solve it. The problem was an important one, because unless the tin could be removed from the iron the scrap could not be remelted in puddling or melting furnaces.

The problem at first did not appear to be very difficult, and it was bound to appeal to the inventor, as the can factories were glad to give their tin scrap away for the asking, and even went so far as to pay cartage simply to get rid of it. However promising the problem appeared, and although many ways seemed to be open for the engineer and chemist, it required many decades of study and experimentation before a feasible method was developed which yielded sufficiently valuable results to make it a paying proposition.

It is not possible here to enumerate all the various suggestions which have been offered to solve the problem, the literature in the field is very extensive and hundreds of patents have been taken out in the United States and abroad. Of these but a very few have really been used.

All the processes which have been actually operated may be divided into three general classes, i.e. the mechanical process, the chemical process and the electro-chemical process.

In the mechanical process the effort was made to separate the tin from the iron by means of heat, and more recently by refrigeration. The methods were impractical, however, for one reason or another, but mainly because it was not possible to obtain a thorough separation of the tin from the iron.

Most of the chemical and electro-chemical processes were also failures, either because the acids used attacked the iron as well as the tin or because they would not dissolve the tin sufficiently and left considerable adhering to the iron. It was also found in many cases that the chemicals used were too expensive to make the process an economical one. Three processes, however, have operated successfully and have been in more or less competition with each other for the last forty years, during which time one or another has alternately obtained preponderance due to refinements in that process over the others. These three processes are the electrolytic alkali process, the chlorine process, and the alkali chemical process.

As far back as the year 1876, Keith\* recommended the electrolysis of tin scrap in an alkali solution, while in 1882 Th. Goldschmidt in Germany conducted experiments with a warm solution of caustic soda, using the tin plate as the anode and the iron plate as the cathode. This exceedingly simple idea has been the basis for the further development of the industry, but however simple such a laboratory experiment may be the operation on a commercial scale often results in a great many difficulties, both electrochemical and mechanical, which have to be overcome. These were undoubtedly met with and probably solved in some manner.

One trouble with the process was the fact that the electrolyte had to be watched constantly, and great care had to be exercised in order to thoroughly separate the tin from the iron. The tin is recovered at the cathode in the form of a spongy or finely granulated precipitate, which may be easily removed and melted. The process, therefore, in spite of the care required offers a considerable advantage as it obtains a serviceable iron in one single operation, which may be compressed into solid billets and for which a market can be readily found. It also furnishes a tin sludge which may be easily melted into pig tin. This fact and the apparent, though not real, simplicity of the process caused it to come into quite general use in a comparatively short time, so that up to about 1907 it practically dominated the entire field.

We now come to the chlorine process, which was taken up first in England by Higgins<sup>1</sup> in 1854, and later by Parmalee<sup>2</sup>, Seely<sup>3</sup> and Panton<sup>4</sup> in this country. At the time the fact was recognized that it was very essential to use only absolutely dry chlorine gas, which will combine with tin under the development of considerable heat to form anhydrous tetrachloride of tin. This is a heavy liquid which fumes strongly in air and has been known to chemists for about 300 years. In fact, as early as 1605 the chemist Libavius described this product, and ever since that time it has been known under the name of Liquid Fumans Libavii.

When dry chlorine is brought in contact with tin clippings, the chlorine and tin will combine and the anhydrous tetrachloride of tin which is formed will drip off. As chlorine at low temperature does not attack iron the process apparently is very simple. Simple as it may seem, however, it required a number of years to develop the process in such a way that it could be used commercially.

A chlorine detinning plant was established in New York City in 1873, operating according to the Seely patent, but the concern failed when the financial panic of that year brought ruin to so many concerns. Further progress was made in chlorine detinning about 1885, when Lambotte in Brussels started to operate on a large scale with a shaft furnace which was filled with tin scrap from the top, while chlorine gas strongly diluted with air, was introduced at the bottom. This chlorine was combined with the tin from the scrap while the air would carry away the tetrachloride of tin to condensers, where it would be condensed as a

watery solution of tetrachloride of tin. The detinned clippings were then removed from the bottom of the furnace and compressed into billets. This process is rather simple in its operation, but the control of the chlorine gas and the tin chloride fumes was difficult and the workmen attending the furnace were greatly annoyed. Furthermore, the detinned clippings could not be entirely detinned and were covered to a certain extent with tetrachloride of tin.

It was not until 1907 that the chlorine detinning process gained real importance as, in that year, Th. Goldschmidt, the pioneers in the detinning industry, abandoned the electrolytic method entirely in favor of the chlorine process which they had developed. Since then it has grown very rapidly, and to-day there are larger quantities of tin scrap and old tin cans detinned with the chlorine process than by all the other processes combined.

Some of the basic conditions of chlorine detinning had been correctly observed by the early experimenters, one of which, and most important, being that all humidity must be excluded in order to avoid a destroying effect on the iron. This is as important to-day as it was then, and it has also been found that the material must be free from all organic substances, such as paper, straw, varnish, etc. The dry tin scrap, therefore, is put into large cylindrical containers either in more or less loose form, or compressed into billets. These containers, after being filled, are closed tight. Dry chlorine is then introduced, and as considerable heat is formed during the combination of tin and chlorine it was early recognized that the heat should not be allowed to raise the temperature of the detinning too high. Means had to be found, therefore, to cool the apparatus and carry off the heat.

In order to achieve a complete detinning the process is carried on under varying pressure so that the chlorine will be forced into every part of the mass of tinned scrap.

After all the tin has combined with the chlorine the liquid tin chloride is removed and the apparatus emptied. The detinned scrap is washed and is then ready to be shipped to the steel mills.

This process possesses considerable advantages over the electrolytic process, as it can be carried on in larger units and the labor charges are therefore materially reduced. The detinning is more thorough and no tin is lost, as in the electrolytic process. The tin is recovered in the form of tetrachloride of tin, which is a valuable chemical product extensively used in the silk dyeing industry. The result is that this process has grown more and more at the expense of the electrolytic and other processes.

We now come to another process which has been touched on previously, namely, detinning by means of alkalis, either alone or in combination with oxidizers. This method was practised at an early stage of the industry, but it did not always remove a sufficient amount of the tin, with the result that a considerable part was left on the iron. It is only within recent years that this process, using alkali and saltpeter, has been developed to a point where the results compare in every respect with the product of the chlorine process.

In this process the scrap is cleaned very carefully and is then placed in a well-heated solution containing

\*U. S. Patent 176,658.

<sup>1</sup>English Patent U.766, 1854.

<sup>2</sup>U. S. Patent 102,148.

<sup>3</sup>U. S. Patent 127,376.

<sup>4</sup>U. S. Patent 135,578.

a considerable excess of free alkali and saltpeter or other oxidizer. The mass is then kept at a boiling temperature for several hours during which the tin reacts to form stannate of soda which accumulates in the form of crystals. These crystals are drawn off and subjected to centrifugal action while the remaining mother lye is diluted with the necessary caustic soda and saltpeter to enable it to be used again in the same way as the original solution.

The stannate of soda is subjected to further treatment by dissolving in water and precipitating oxide of tin by means of bicarbonate of sodium. It should be borne in mind that the alkali used in this process is always recovered and used over and over so that only a very small loss results. The saltpeter is also recovered at the end of the operation with the exception of the amount required for the oxidation of the tin.

The tin oxide obtained in this process is used extensively as a coloring matter in the enamel industry or is smelted in reverberatory furnaces to form pig tin of very high quality.

The Goldschmidt Detinning Company uses this process as well as the chlorine process in its various plants and its output therefore in addition to detinned scrap comprises large amounts of tetrachloride of tin and pig tin of a purity which in every respect is the equal of Straits tin. The company recovers every year the equivalent of almost 2000 gross tons of metallic tin.

## Synopsis of Recent Metallurgical and Chemical Literature

### Radium

**Radium Luminous Compounds.**—The discussion of a paper on investigations of radium luminous compounds read at a meeting of the Physical Society of London by C. C. PATERSON, J. W. T. WALSH and W. F. HIGGINS is given in *The Chemical Trade Journal and Chemical Engineer* for June 16, 1917.

The paper contained the results of measurements made on various samples of radium luminous compounds during the last two years. Determinations of the brightness of the compound in powder form and when made up into paint, and also after the application of the paint to instrument dials, were carried out, and curves were given showing the rates of decay of luminosity. The radium contents of the compounds were determined by comparison of their  $\gamma$ -ray activities with that of a preparation of pure radium bromide, which is periodically compared with the British radium standard. The various precautions which have to be observed and the corrections which have to be applied in making the various determinations were explained, and the considerations which should govern the proportion of radium employed for practical purposes were discussed.

In the discussion which followed Mr. F. H. Glew said the difference between some of Marsden's results and those of Dewar and Crookes had been attributed to some difference in the zinc sulphide employed; he could state that the sulphide supplied to the National Physical Laboratory was of different origin from either of these. Before the war we were almost entirely dependent on foreign sources for the supply of these materials, but

we are now quite self-supporting. In Marsden's work the inside of the tube was completely coated with sulphide, so that the effects were observed by light transmitted through the material. It was better to paint only one-half of the tube, so that the inner surface, which was exposed to the bombardment, could be directly observed. It was singular that specimens prepared by the dry and wet methods should be so similar in their properties after only four days, for in the dry method the emanation and all its products are retained.

Dr. H. S. Allen asked if the zinc sulphide employed was wholly crystalline or partially amorphous. An investigation of its physical condition would be useful.

Mr. J. S. Dow said the figures for the absolute brightness were what he would have expected. He was doubtful of the possibility of expressing the brightness accurately; consistent results could be obtained, but they did not represent exactly what the eye saw. For instance, zinc sulphide and cadmium sulphide may be equally bright a few inches away, but the former will look much brighter at a distance. Had the authors noticed any change of color as the compound got older? He thought it got greener as it aged. The initial rise in the luminosity curves for the weaker materials seemed greater than could be explained by the lower rate of decay.

Dr. Levy said he had found the luminosity of different samples of zinc sulphide to vary perceptibly in tint when stimulated by daylight, but had not noticed this with  $\alpha$ -ray stimulation. In his experience, if a sample of sulphide gave good results when stimulated by daylight, it would also be good when stimulated by radium. The reverse did not hold, however, as a specimen might be poor with daylight, but good with radium excitation.

Mr. Walsh, in reply, said that to detect change of color with age would have been difficult in their experiments, because of the continuous decrease in luminosity. They had detected differences in color in samples sent by different makers, but were unaware whether these were from the same source, or made in the same way. They had no data on the relation between daylight and radium excitation, and Dr. Levy's remarks were of great interest.

### Iron and Steel

**Sulphur as a Component of Furnace Slag.**—A very interesting article on the mentioned subject was published in *Blast Furnace and Steel Plant* of July, 1917, by WALLACE G. IMHOFF. As is well known, sulphur occurs in slags in three forms, first, as combined sulphur in the form of calcium sulphide, second, free sulphur held in solution in the slag, and third, sublimated sulphur, the result of an excess of sulphur in the burden.

The sulphur in a furnace charge is mainly in the ore and coke while only small amounts are found in the flux. With lake ores the sulphur going into the furnace will fall within the limit of 1½ per cent, while furnaces, and especially merchant furnaces, with high sulphur coke and pyrites cinders in the burden will run as high as 6 and even 8 per cent in sulphur.

The author cites two examples, figuring in one case the amount of lime required to slag a high percentage of sulphur and in the other where the percentage of sulphur is lower. Careful regulation of the lime is essential since most of this sulphur is eliminated in the slag, although some is carried out by the furnace gases.

In the second example the writer shows the effect of excess lime on the furnace operation. The excess limestone lowers the temperature of the furnace, fluxes the silica, and absorbs the silicon normally entering the iron. Thus as conditions grow worse, and the furnace gets cooler, the silicon content of the iron is lowered, and the sulphur in the iron increases. This accounts for irons extremely low in silicon and high in sulphur resulting when a furnace cools off from being "over-limed." Very often in practice more stone is added as the sulphur in the iron rises, only making the conditions more extreme and resulting in the formation of a very infusible slag: a slag which will at times fill the bottom of the furnace, freezing in the bosh and often terminating in a complete shutdown.

The largest amounts of calcium sulphide are found in foundry-iron slags, which as a rule are high in alumina. The author states that the alumina fluxes the bulk of the silica, while the lime fluxes the sulphur and only a small proportion of the silica. These foundry-iron slags under normal conditions usually show a blue color due to the aluminium silicate. As soon as the furnace gets cool the slag becomes glassy due to silica going into the slag as such. If the furnace is permitted to get still colder, lime silicates will be formed, when the slag is creamy white in color. Then the iron will show an increase in sulphur content, as is shown in Fig. 1, below. A hot furnace working a slag heavily oversatu-

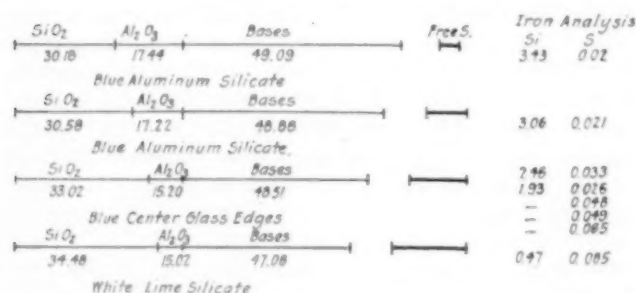


FIG. 1—RELATION OF SLAG COMPOSITION TO SULPHUR IN IRON

rated with calcium sulphide and a high-sulphur burden produces a very heavy, smoky gas, giving rise to a white deposit near the tuyeres. Some of this deposit was analyzed and found to contain 4.20 per cent CaO and 10.73 per cent sulphur. Analyses of slags drawn from such furnaces seem to indicate that these oversaturated slags give rise to such fogs on reaching the atmosphere.

Indirectly calcium sulphide effects the condition of the carbon in the pig iron. When the furnace is working with very heavy lime, a hot bottom and high combined sulphur, the cast house is generally filled with graphitic carbon. This indicates that the formation of calcium sulphide in the slag has a tendency to promote the formation of graphite in the pig iron. The large amount of graphitic carbon in the iron makes the product extremely dry and mushy. Other effects of a hot furnace and heavy lime are: slow working and low fusion zone. The latter is due to the formation of large amounts of combined sulphur.

The author then gives a discussion of basic slags and slags obtained with foundry iron. He illustrates the heating value of the gases obtained in both instances and explains why basic-iron slags generally show less

combined sulphur than do the foundry-iron slags. He then states that it is very seldom that all the sulphur present in slags is in the combined form. Some always occurs in the free state and it may be observed in any gas cavities. The foundry-iron slags very high in aluminium which are solid, dry, dense, and grainy are those carrying the largest percentage of combined sulphur. The average basic slag contains less than 1.75 per cent sulphur and the average foundry-iron slag varies between 1.60 per cent and 2.50 per cent of combined sulphur. The combined sulphur depends mainly on the total sulphur entering the furnace, the position of the fusion zone, the hearth temperature, and the slag volume.

The relation of the sulphur in the slag to the slag volume is as follows: Assuming the total sulphur going into the furnace to be practically constant and all other furnace conditions remaining the same, the sulphur content of the slag will be inversely proportional to the slag volume.

**Quantitative Determination of Air Dust.**—In the *Heating and Ventilating Magazine* for June, 1917, E. Vernon Hill of the Department of Public Health, Chicago, Ill., gives a review of the various methods devised for the determination of the number of dust particles in air, discusses the difficulties encountered and describes types of dust counters developed by him. The latest of these consists essentially of an exhaust pump of known capacity for handling the air and a small capsule or shell affixed to the inlet of the pump, carrying a cover glass, coated with adhesive material for catching and retaining the dust. The author's first experiments in this line were made by drawing a quantity of air into a syringe and forcing it out against a slide covered with adhesive material and counting the number of particles with a microscope. In using this method he found a serious source of error in the retention of dust particles in the barrel of the pump. A device was, therefore, arranged to carry the cover slip on the interior of the pump directly beneath the intake nozzle. With this arrangement the dust was projected against the adhesive material before coming in contact with the interior of the pump.

This was the first instrument developed in the long series of tests with which a consistent and practical determination could be made. In developing the idea just described the next step was to find some means of calibrating the instrument. It was evident that all of the dust projected against the adhesive plate was not retained, some must of necessity escape. A number of capsules were therefore constructed as a separate part of the instrument and designed them in such a way that one could be superimposed upon the other and the air sample drawn through them in series. By experiment it was found that with six such capsules under ordinary or moderately extreme conditions of air dustiness no dust was found in the last capsule. Counts were then made of the samples in the consecutive capsules and a percentage determination arrived at for the amount retained by the first capsule. In routine tests with the instrument, therefore, it is only necessary to use one capsule and correct the result by the factor given for the nature of the work in hand. This for ordinary tests is 62 per cent. The author states that it is not only possible to accurately deter-

mine the number of dust particles, but a study of the kind and character of the dust under observation is often instructive and valuable. This feature greatly enhances the value of the method and makes the work extremely interesting. Counted by this method the particles in clean, outdoor air average from 500 to 1500 per cubic feet. In a mechanically-ventilated school room, without air washers or other air cleaning device, from 10,000 to 30,000. It is also a practical method for testing the efficiency of air washers. For this purpose a "Y" connection is used on the pump and two capsules used simultaneously, one at the proximal and one at the distal end of the washer, connections being made to the pump with rubber tubing.

Some experimental results obtained by two students of the Armour Institute of Technology in work of this kind are of interest. Messrs. Otto Armpach and E. W. Haines made the tests in preparing their graduation theses. The tests were conducted during March and April of the present year on a Webster air washer furnished by Wm. G. Braemer, then manager of the air conditioning department of Warren, Webster & Co., in the experimental laboratory of the Ventilation Division of the Chicago Health Department.

#### QUANTITATIVE DETERMINATIONS OF VARIOUS KINDS OF DUST REMOVED BY AN AIR WASHER

	Medium	Heavy
Lamp black .....	89.4	91.2
Rubber dust .....	90	92.3
Street dust .....	96.2	98.2
Wood dust .....	96.5	99.2
Grain dust .....	98.5	99.2
Rattler dust .....	99.5	99.7

The "medium" and "heavy" at the head of the two columns refer to the amount of dust that was liberated in vicinity of the intake of the washer. These are the only tests of this character that the author knows of in the literature of air conditioning work.

A statement previously advanced by the author is brought out clearly in these tests, viz., that the per cent of efficiency in dust removal of an air washer increases directly with the amount of dust entering the washer. In every instance these tests show the per cent of removal higher when the quantity is "heavy." The author emphasizes the statement: that with any method of dust determination the results are relative only, they cannot be absolute. This is due to the fact that a considerable number of the minute dust particles that are always present are not caught in the liquid when dust is collected by bubbling through water but pass through with the bubbles, the amount retained increasing as the size of the bubbles and velocity of air passing through the liquid decreases. He has repeatedly drawn room air through a Drechsel bottle with a 3-in. water seal and counted as high as 7000 small particles per cubic foot that were not retained in the water. Air passed through four wash bottles in series still gives a light beam with the diffractoscope. On the other hand, while much of the dust that passes through the wash bottle can be collected and counted with this latest dust counter, even with this instrument some particles are so small that the magnification used does not reveal their presence.

## Recent Metallurgical and Chemical Patents

### Iron and Steel

**High-Speed Steel.**—An alloy high-speed tool steel of the tungsten-chromium-vanadium type is patented by James H. Parker of Reading, Pa., and B. H. De Long of Springmont, Pa. (assigned to Carpenter Steel Company of Reading, Pa.). The alloy has a high proportion of cobalt and has approximately the following composition:

	Per Cent
Carbon .....	0.35
Vanadium .....	2.00
Chromium .....	3.50
Tungsten .....	12.00
Cobalt .....	30.00
Iron .....	52.15
	100.00

The proportions of iron and cobalt correspond with the eutectic proportions. It is claimed that the alloy will give maximum service with increase of possible speed and cut. (1,233,118, July 10, 1917.)

**High Speed Tool Steel Alloy.**—A patent issued to Radclyffe Furness of Jenkintown, Pa. (assignor to the Midvale Steel Company), states that if a certain amount of both cobalt and tungsten be added to an ordinary high-speed tool steel, containing tungsten, chromium and vanadium, a substantial increase in cutting efficiency is attained. The amount of uranium is so small that it cannot be said to replace the known high-speed tool steel additions, its presence even in apparently negligible proportion improving the efficiency of the tools.

	Preferred Analysis, Per Cent	Limiting Proportions, Per Cent
Cobalt .....	4.5	3.0 to 7.0
Uranium .....	0.7	0.1 to 2.0
Tungsten .....	13.5	12.0 to 20.0
Chromium .....	3.5	2.0 to 6.0
Vanadium .....	1.5	0.5 to 2.0
Carbon .....	0.7	0.5 to 0.9

(1,233,862, July 17, 1917.)

**Deoxidizer for Steel Baths.**—J. I. Bronn of Rombach, Germany (assignor one-half to Rombacher Huttenwerke), patents a substitute for ferromanganese or other expensive de-oxidizers to produce a workable steel. The oxygen containing iron baths obtained at the end of the Bessemer or open-hearth processes are de-oxidized with a molten pig iron high in phosphorus. If a calculated amount of phosphorus is used to react with the oxygen in the bath, no substantial impurification results. Under certain circumstances it may be advisable to charge an excess of phosphorus, which can easily be removed by a short refining without appreciably re-oxidizing the metal. The deoxidizing effect of the addition of Thomas pig iron to the converter charge appears from the following comparative data relating to working with Thomas pig iron containing 0.45 per cent silicon, 1.20 per cent manganese, 1.85 per cent phosphorus and 3.5 per cent carbon.

	Mn, Per Cent	P, Per Cent	C, Per Cent
Iron bath at end of blow .....	0.19	0.045	0.05
After addition of Thomas pig-iron .....	0.25	0.085	0.07

It is advisable to add the molten phosphorus containing pig iron in the converter after skimming in order to

improve the intermixing. In connection with the open-hearth furnace the bath is refined as usual and the iron rich in phosphorus added in the molten condition when the furnace charge is nearly finished. Care is to be taken that the slag layer on the iron bath is not very high in phosphorus and that it is in as thin liquid condition as possible. The following comparative data show the effect of the addition of Thomas pig iron:

	Mn. Per Cent	P. Per Cent	C. Per Cent
The furnace charge (33 tons) after refining contained .....	0.26	0.030	0.10
The Thomas pig iron addition (1500 kg.) contained .....	1.75	2.78	3.5
The deoxidized bath contained .....	0.43	0.062	0.15

The bath shows an increase in manganese over the amount of manganese contained in the pig iron addition, namely:

The bath contained .....	$330 \times 0.26 = 85.8$ kg.
And the addition .....	$15 \times 1.75 = 26.1$ kg.
This makes together .....	111.9 kg.

whereas the bath contained as above stated 0.43 per cent manganese or 148 kg., so that an increase of 36.1 kg. manganese has taken place. The phosphorus on the contrary shows a considerable decrease, namely:

The charge contained .....	$330 \times 0.03 = 9.9$ kg.
The addition .....	$15 \times 2.78 = 41.8$ kg.
This makes together .....	51.7 kg.

whereas the bath contained  $345 \times 0.062 = 21.3$  kg., so that a decrease in phosphorus of 30.4 kg. has taken place which have been used for deoxidizing purposes. These data relate to the pig and ore process. Similar results are obtained in connection with the pig and scrap process. If compared with the usual deoxidation process with ferromanganese alone the deoxidation with pig iron (Thomas pig iron) rich in phosphorus results in saving 2 kg. metallic manganese or 4 kg. ferromanganese with 50 per cent of manganese for each ton of steel. (1,233,970, July 17, 1917.)

### Zinc Distillation

**Condenser to Produce Pure Zinc.**—A patent issued to A. J. F. de Bavay, Kew, Victoria, Australia, covers a proposed construction of condenser where pure zinc may be attained by the separation of other volatile metals by passing the complex distillate seriatim through a series of differentially heated liquid condensates. In practice, the condenser *B* is just charged with

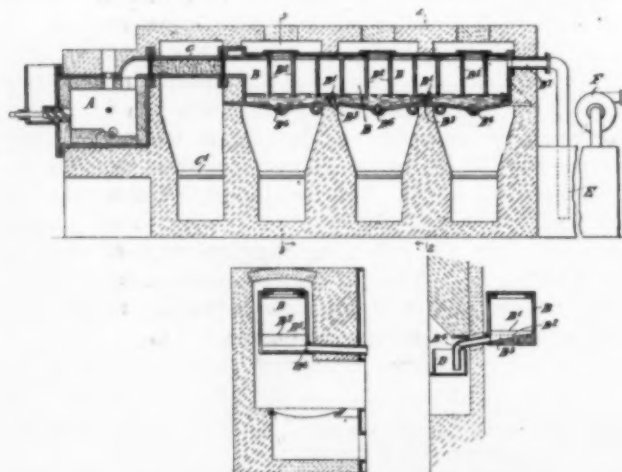


FIG. 1—ZINC DISTILLATION FURNACE

the proper amount of molten zinc sealing the downwardly projecting baffles *B*<sup>2</sup>, and a reducing gas containing zinc vapor drawn from the furnace *A* by the suction of the fan *F*. Three compartments are shown, separated by the upwardly projecting baffles *B*<sup>1</sup>. These baffles are formed with a groove *B*<sup>3</sup>, with the near side slightly lower than the other, the groove being connected to a pipe *B*<sup>4</sup> (Fig. 1) dipping into a pot *D* of molten zinc of sufficient head required by the fan suction. In this way a constant level of the bath is maintained, zinc being ladled from *D* from time to time as it accumulates. Each compartment has also a drain *B*<sup>5</sup>. The temperature in the various chambers is above the melting point of zinc, and is differentially decreased toward the fan. The metallic vapor is drawn through the molten zinc, passing from one compartment to the other, being practically freed from fume at the exit. The impurity lead is mostly collected in the first compartment, while the molten zinc in the succeeding chambers is differentially free from other impurities, and cadmium-zinc may be collected in the last condenser. (1,233,652, July 17, 1917.)

### Glass

**Quartz-Glass-Making Machine.**—A machine for making tubes, flasks, etc., of quartz glass is patented by Armin Frost of New York, N. Y. It consists of a cylindrical melting chamber having a double wall, the space between the walls being filled with the same material that the vessels are to be made from, in order to prevent radiation and loss of heat. The melting chamber is filled with the charge and heated by a graphite rod passing through the center of the chamber and connected at each end with a source of current. When the annular core surrounding the rod is melted, the current is turned off and the furnace withdrawn from the upper electrode by lowering the elevator upon which the melting chamber rests.

In the opening at the top of the tube formed by the core, after the graphite rod has been withdrawn, is inserted a blowpipe, the tube being tightly closed upon it, so that no air can escape and the desired thickness of the tube attained by the proper lowering of the elevator, taken in connection with the admission of compressed air, causing the tube to be formed uniformly thick and straight.

The molten glass still remaining on the electrode in the melting chamber is let down by the elevator and inclosed in molds of the proper shape, the glass being forced outwardly by the compressed air entering through the pipe. (1,232,785, July 10, 1917.)

**Thermostat.**—The accompanying drawing represents a vertical central section through the apparatus, some of the parts being shown in side elevation, invented by Niels Bendixen of Copenhagen, Denmark, which operates as follows: By a swift rise of the temperature the fluid in the receptacle 4 is vaporized, whereby the pressure of the vapor acts upon the diaphragm 6, the pin 8, and one end of the spring 12, so that the latter moves upward. The contact 14 thereby will come in touch with contact 15 and close an electrical circuit through the wire 22, the stud 2, the spring 12, the contacts 14 and 15, the spring 13, the stud 3 and the wire 23, thereby operating the alarm bell or the like, which is inserted in the circuit. The fluid in the receptacle 5 is only slightly influenced by the sudden rise of the tem-

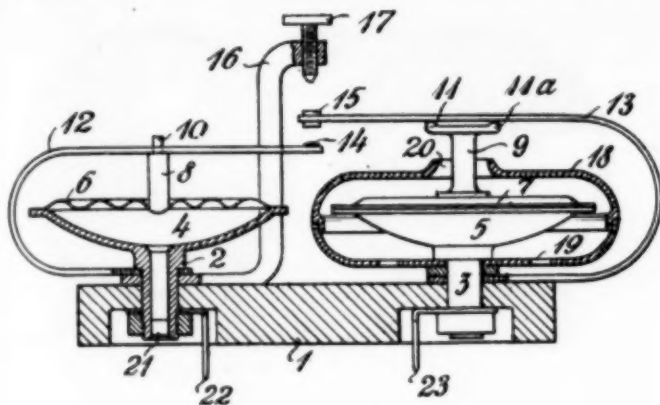


FIG. 2—CROSS-SECTION OF THERMOSTAT

perature, because this receptacle is protected by the case 18, so that the spring 13 and the contact 15 remain in almost unaltered position. By a slow rise of the temperature the receptacle 5 will be heated almost as swiftly as the receptacle 4, the air circulating through the openings 19 and 20. The contacts 14 and 15 will therefore both move upward, but without touching each other. When the rise of the temperature has reached a certain height, the contact 15 will touch the screw 17, and a circuit is then closed through the wire 22, the stud 2, the rod 16, the screw 17, the contact 15, the spring 13, the stud 3 and the wire 23. Of considerable importance to the invention is the particular shape of the pin 9. When the spring 13 is in its central position—as shown in the drawing—it is touched by both bifurcations 11 and 11<sup>a</sup>. If the temperature rises, so that the spring 13 is moved upward, it is only touched by the point 11<sup>a</sup>, and the speed of the contact 15 is thereby increased. If the temperature is lowered, so that the spring 13 moves downward, the arm of the lever is altered, so that the speed of the contact 15 decreases. This arrangement is very advantageous for preventing errors which may arise on account of the diaphragms not being manufactured quite similarly and therefore not moving with the same speed. (1,233,746, July 17, 1917.)

#### Heat Treating

**Automatic Heat-Treating Furnace.**—The continuous pusher-type furnaces mentioned in our issue of July 15, 1917 (Vol. XVII, page 91), have been patented by T. F. Baily and F. T. Cope, assignors to the Electric Furnace Company. The operation is as follows: The billets A are placed one at a time upon the extension 8 of the billet support. As the temperature in the rear end of the heating chamber 7 adjacent the thermocouple 10 reaches the proper degree, the thermocouple moves the arm 13 into engagement with the contact plate 18 closing the relay 16, thus closing the circuit through the solenoid 21 (shown in Fig. 3). The arm 32 is drawn toward said solenoid, connecting the pipe 36 with the water supply. The water operates the pistons in the cylinders 37 and 38, opening the doors of the furnace and pushing the billet which has been placed upon the outside of the door into the heating chamber against the other billets, moving all of them forward. The billet adjacent the door 5, being heated to the proper degree, is pushed from the furnace down the inclined chute 9 into the quenching trough, where it is properly quenched and picked up by the continu-

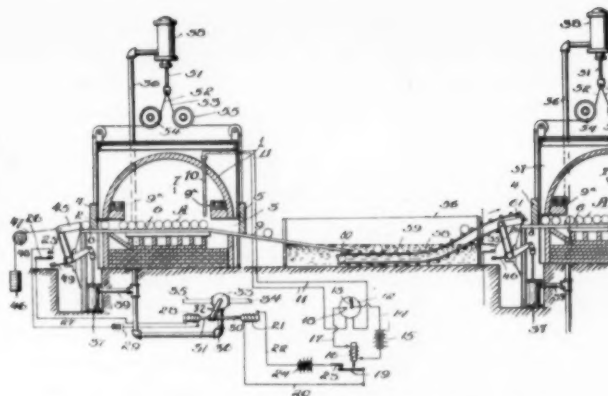


FIG. 3—AUTOMATIC HEAT-TREATING FURNACE

ously operating endless carrier 58, which carries it upwardly and deposits it upon the billet support of the annealing furnace 57, from where the billet is carried through the annealing furnace in the same manner in which it has been moved through the hardening furnace, the mechanism connected with the annealing furnace operating in the same manner. As the finger 49 comes into contact with the pivoted arm 26, it moves the arm into contact with the contact plate 25, closing the circuit through the solenoid 28. The temperature within the heating chamber of the furnace 1 will by this time have been lowered sufficiently to cause the arm 13 of the pyrometer to move out of contact with the contact point 18, thus breaking the circuit to the relay 16 and to the solenoid 21. The armature of the solenoid 28 will then be operated, moving the arm 32 back into the original position connecting the pipe 36 with the discharge. The weight of the doors will then cause them to close and the counterweight 46 will bring the pusher back to the normal position. (1,234,257, July 24, 1917.)

**Binding Material for Briquettes.**—A binding material and the method of preparation is invented by Walther Mathesius, Berlin-Nikolassee, Germany. It is based upon the fact that finely pulverized iron oxide and hydroxide will enter into the molecule of free lime or aluminosilicates containing a high percentage of lime, forming ferroalumina silicates of lime at temperatures below the temperature of sintering, after which heating the material is still easy to pulverize. The resulting substance on being mixed with further iron ore or iron oxide bearing material, moistened or molded, will agglomerate most perfectly and furnish excellent stable briquettes. (1,233,384, July 17, 1917.)

#### Conditions in the Abrasive Industry

Col. P. R. Hawkins, of the Norton Company, Worcester, Mass., has supplied the following statement regarding conditions in the abrasive industry to Maurice R. Scharff, executive secretary in Washington of the Technology Clubs Associated.

"We wish to bring to your attention the probable shortage in abrasives, grinding wheels and grinding machinery necessary to manufacture the large quantity of munitions and other supplies required by the United States Government.

"Imports of emery have practically ceased during recent years so that the grinding wheel industry is dependent upon artificial abrasives. These are manufactured from bauxite and carbide of silicon. The leading

and perhaps best known abrasive manufactured from bauxite is Alundum, and Crystolon and Carborundum are examples of those made of carbide of silicon.

"There is a great shortage of cars necessary for the shipment of bauxite from the mines in Arkansas to the places where abrasives are manufactured; the power supply at Niagara Falls, where the important abrasive plants are situated, is likely to be inadequate; we cannot obtain sufficient alumina to make the necessary amount of white alundum, a special abrasive used principally for munitions grinding wheels, and if the draft should to-day take all the men registered in our works we would lose fully 45 per cent of our organization. These are some of the problems which confront abrasive manufacturers at the present time. Norton Company, the largest manufacturer of grinding wheels in this country, is doing what it can to meet these conditions, but the situation should be thoroughly understood by those who are working in the interests of the Government.

"We have the example of England which did not appreciate the situation with regard to grinding wheels and found itself in a very serious position on account of the lack of wheels for grinding shells, gun barrels and other necessary munitions work. The Munitions Board of Great Britain finally sent representatives to this country and we, among others, were very urgently appealed to to help relieve the situation, which we did to the greatest possible extent. We expect a similar condition to occur in this country and everything possible should be done to anticipate the shortage."

### Washing Filtercloths

An interesting machine for washing filter cloths is made by the Clenzall Machines Company of America, St. Louis, Mo., under the name of the "Clenzall" washing machine. An illustration of this machine is shown in Fig. 1.

The apparatus consists in its essential parts of an outer case and an inner drum. The inner drum is

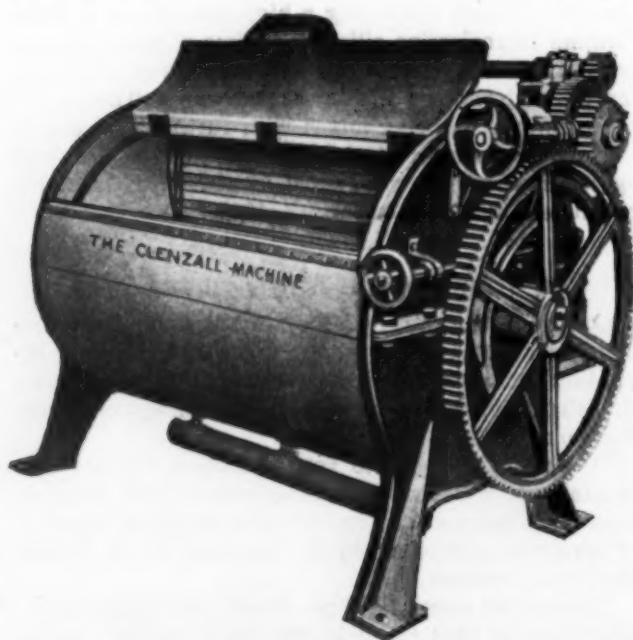
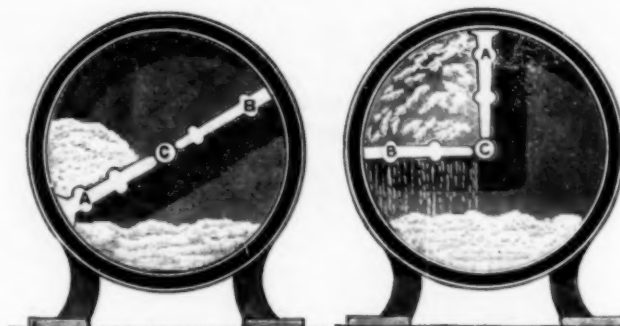


FIG. 1—GENERAL VIEW OF MACHINE FOR WASHING FILTER CLOTHS



FIGS. 2 AND 3—INTERIOR VIEWS OF MACHINE

divided into two compartments by a diaphragm, the upper half of which A is mounted on shaft C and is held in position by springs fixed to the outer case, while the lower half B is fixed to and moves with the inner drum.

The machine is loaded on both sides of the diaphragm as shown in Fig. 2 and being set in motion, the cloths on one side are lifted out of the washing liquor while those on the other side spread out in and absorb the liquor, as shown. During this part of the operation the diaphragm is fixed in a straight line, thus dividing the drum into two equal compartments.

When in action, the inner drum never makes a complete revolution, but only moves through three-quarters of a circle. This insures the rubbing action necessary for a superficial washing and prepares the cloths for the squeezing action which takes place later.

After this rubbing action has gone on for a few minutes, the clutch is altered so that the diaphragm B moves with the inner drum while the diaphragm A remains fixed to the center shaft C. The squeezing action now begins.

The cloths are then carried upward on B until they come in contact with A and are squeezed. The drum then reverses automatically and the cloths are rubbed.

The machine is supplied complete with all gear wheels, pulleys, automatic reversing gear, water and steam inlets and outlets, etc. The outer case is made of galvanized steel plate and the inner drum of brass and fitted with the patent movable diaphragms.

Taking an ordinary example, the standard size of machine will deal at each operation with about fifty to sixty cloths each measuring about 27 x 54 in. (that is to say, cloths that would be used on a press with plates 25 in. square). In the majority of cases only hot water and steam will be necessary, when the washing time would be about fifteen to twenty minutes, but with oils, varnishes and similar materials the time would be somewhat longer, depending upon the nature of the filtrate, and for these it is necessary to use special solvents.

Although this machine is primarily intended for washing filtercloths, it is being used with entirely satisfactory results for washing overalls, sponge cloths, cotton wipers, bags, etc.

### New Types of Industrial Cars

The many new processes developed since American industries were thrown on their own resources in the matter of chemicals have necessitated much new and special equipment.

The illustration, Fig. 1, shows a new type of side dump car, built for the Contact Process Company by the Orenstein-Arthur Koppel Company of Koppel, Pa.

The material to be transported comes from the furnaces in a liquid form at a comparatively high temperature and solidifies on cooling. These cars were specially designed in order to provide an efficient means for handling and transporting this material, which flows directly from the furnaces into the cars.



FIG. 1—SIDE DUMP CAR WITH COVER

When the body is filled the cover is applied and the car allowed to stand until the material has solidified. The cover is then removed, the car body is tilted over and the solid cone slides out of the body in convenient form for further transportation.

The accompanying illustration, Fig. 2, shows a striking difference between standard American practice and that of South America in the design of dump cars.

The car shown here is of the square-box, side-dump type, built by the above company for use in the South American nitrate industry.

The cars are of exceptionally heavy steel construction in order to stand up under the severe operating conditions which prevail in the nitrate field.

They are supported on cast steel cradles, designed so that they require a minimum amount of effort to dump and right them. When the car is dumped it tilts to a considerable angle before the door latches are knocked off, thus insuring a clean discharge and causing the load to be thrown clear of the rails.

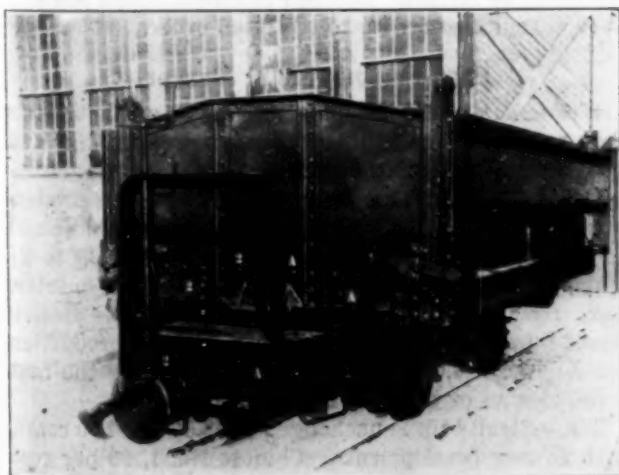


FIG. 2—SQUARE BOX SIDE DUMP CAR

## Personal

Mr. Charles J. Barr, formerly general superintendent of the Ensley steel plant of the Tennessee company, will be the new general manager of the Fairfield works of the same company.

Dr. Charles Baskerville, professor of chemistry in the College of the City of New York, has been appointed by the Ramsay Memorial Committee to organize a committee in the United States for receiving subscriptions to the fund from Americans.

Mr. W. H. Coghill of the Bureau of Mines will assist Thomas Varley, superintendent of the Seattle station, in the investigation of ore dressing, which is to be one of the principal lines of work at the Seattle station. Mr. Coghill will continue his work on the molecular physics of flotation as applied to Oregon ores.

Dr. J. Ehrlich has been appointed chief chemist of the Verona Chemical Company, North Newark, N. J.

Mr. A. W. Hudson of the Phelps Dodge Corporation, Research Staff, has moved to Burro Mountain Copper Company branch to conduct some large scale experiments for the company.

Mr. J. C. Mooar has been appointed acting manager of the Atlanta sales office of the Pratt Engineering & Machine Company, owing to the absence of the manager of the office, Mr. J. B. Jacoway.

Mr. Fred W. Padgett, who for the past four years has been research fellow in oil, gas and gasoline in the University of Pittsburgh, has been appointed associate professor of chemistry in the University of Oklahoma, where he will have charge of developing a research department in oil, gas and gasoline.

Mr. E. Gybbon Spilsbury sailed from New York on July 26 for Central America and expects to be absent until the end of August.

Prof. Ernest E. Thum has joined the staff of METALLURGICAL AND CHEMICAL ENGINEERING as associate editor. He is a graduate of the Colorado School of Mines. His first professional experience was as draftsman with the Minnequa Plant of the Colorado Fuel and Iron Company, during the construction of the East mills. From 1906 to 1914 he was employed by the Anaconda Copper Mining Company, first at the Washoe plant as constructing engineer on hydroelectric and water supply development, then as draftsman on the stack and flue system at the Great Falls plant. He then acted as chief civil engineer in the construction of the Tooele plant of the International Smelting & Refining Company, and upon the completion of this work was transferred back to the Great Falls plant, where he was engineer in charge of construction during the reconstruction of the smelter departments of that works. On cessation of operations due to the outbreak of the European war, Mr. Thum became assistant professor of metallurgy at the University of Cincinnati, taking charge of the department of metallurgical engineering in Dean Schneider's Co-operative Engineering College. During his teaching experience, Mr. Thum published "A Practice Book in Elementary Metallurgy" as well as a number of articles in the technical press.

Mr. John T. Wilkin has been elected president of the Connersville Blower Company, Connersville, Ind., in addition to his duties as engineer. Mr. Wilkin was one of the organizers of the company in 1892.

## CURRENT MARKET REPORTS

### The Iron and Steel Market

The stagnation in the iron and steel markets has continued. Practically nothing has been done in scrap, dealers being afraid to buy or sell or even to match sales and purchases. Business in pig iron has been confined to a relatively few small lots for early shipment. There has been no tonnage of the least importance in unfinished steel. Transactions in finished steel have been in small lots for relatively early shipment, together with a very moderate volume of contract business, placed on mill books at inside prices to take care of regular customers.

There has been no demand and likewise there have been no offerings. The producers know they could not sell by trying to force the market. It is a waiting game, and while nothing seems to transpire the fundamental conditions are rapidly lining up for a complete rehabilitation in the market. This is absolutely necessary in order that business may go on. The entire steel output of the country could not possibly be absorbed at the prices lately quoted as the market. Those prices have been fictitious in the sense that they are not applicable to the great bulk of the production. They have been obtained only on relatively small sales to buyers peculiarly situated. Some few make finished wares of such character that the cost of the steel in them, however great, is a mere bagatelle. Other buyers have been fairly well covered at much lower prices, and bought small tonnages at fancy prices to eke out, the average cost of the total being moderate.

A few weeks ago the iron and steel trade was in the throes of discussion whether there would be regulation of prices by the Government. Some authorities did not seem to realize that the Administration had been given no authority to regulate prices, except as to its own purchases. Nearly all expressed the conviction that Government regulation would be very awkward if not impossible. When the iron and steel price control feature was dropped from the Food Control bill in the Senate (the bill as finally approved provides for strict control of coke prices only) the trade began to realize that possibly the market would adjust itself. Scrap prices had started to decline, pig iron had softened, and finished steel prices had ceased to advance, before President Wilson made his appeal for the foregoing of "unusual profits" and for "one price to all." That statement was published July 12. Since then the trade has marveled more and more at the complete stagnation that followed it, and has come to admit that the natural laws of business decree that iron and steel prices must come down to a reasonable level before trading can be resumed.

The President's finesse did not stop with the "appeal" of July 12. An embargo has been placed on the exportation of certain iron and steel products without licenses and it has been intimated that the granting of licenses is to be greatly restricted, while additional commodities may be included in the embargo list. The Government purchases of steel have been made chiefly on the basis of prices to be fixed later. Purchases on behalf of the Entente Allies have been almost entirely held in abeyance. To the keen observer of iron and steel market habits all this appeals as finesse of the highest order. President Wilson has no power to dictate prices for the

iron and steel market at large and undoubtedly would prefer that there should be no occasion for such authority to be given or exercised. Time will provide the readjustment through the operation of natural laws.

Reference has been made to the so-called "law of supply and demand." For nearly two years it was a case of demand rather than of requirements. Demand is what the buyer calls for, not what he requires. For nearly two years demand was based upon the buyer's fears, that if he did not buy far ahead he would secure no material when the time came. Now, when that period of fear is fully ended the jobbers and manufacturing consumers generally are found to be fairly well stocked with material. Some jobbers are going far afield to dispose of surplus stocks. Manufacturing consumers have reduced their specifications against current contracts. As to actual requirements in the future it is obvious that there are to be great reductions in many quarters, for instance, practically no new building projects are being undertaken and the railroads are out of the market.

The war requirements in steel are proving to be rather lighter than expected. It is impossible to make close estimates, but some measure of the possibilities may be obtained by considering that last year the production of rolled steel in the United States was 30,500,000 tons while the production in England was 7,500,000 tons. The British production was absorbed very largely in the prosecution of the war, apart from such portion of the 2,400,000 tons exported as did not go to England's allies for war purposes. If the United States should use as much as England, or twice as much, the remainder, for the arts of peace, would be extremely large, and a relatively small decrease in such consumption would release the steel needed for the war. It is to be noted furthermore that while the production of steel ingots in the United States in 1916 was about 41,500,000 tons, the present capacity is about 49,500,000 tons, while nearly 4,000,000 tons is under construction.

The general price readjustment has already started, and quite in accordance with the precedents established in previous declines. Scrap began to decline late in June and pig iron softened somewhat, early in July. In the past few days there have been offerings of unfinished steel at prices much below those formerly ruling, there being offerings of billets at \$85, or \$10 below the previous market, and of sheet bars at \$90, or \$15 below the previous market. Declines in finished steel are still to come, quite according to the usual order.

### Non-Ferrous Metal Market

*Wednesday, Aug. 8.*—Prices in most of the metals have remained practically stationary. Copper, tin, lead and spelter are all unchanged.

*Copper.*—The hot weather affected both the production and consumption of copper. Electrolytic is quoted at 27.50 to 28.25 cents for prompt delivery; 26 to 27 cents, third quarter and 24.50 to 25 cents fourth quarter. Lake remains unchanged at 29.50 cents. The Boston News Bureau estimates the copper refinery production for July as 180,000,000 lb. with the total for the first seven months of the year 1,235,000,000 lb.

*Tin.*—Straits tin is unchanged at 63.50 to 64.00 cents, with no new developments. Chinese No. 1, 99 per cent is offered at 55 to 56 cents. Banca tin is held at 60.00 to 60.50 cents.

**Lead.**—The trust price remains at 11.00 cents spot, New York. Independents are, however, offering lead at 10.75. The Government is understood to have purchased 8000 tons more at 8.00 cents St. Louis.

**Spelter.**—The Government has asked for open bids on 11,500,000 lb. of grade "C" spelter, thereby deviating from its method of purchasing grades "A" and "B" which it decided to purchase at cost plus a fair profit. It will be interesting to watch the outcome of this bidding. Prompt spelter is quoted at 8.75 New York.

## OTHER METALS

Antimony, Chinese and Japanese lb.	\$0.15
Aluminum, No. 1 Virgin, 98-99 per cent, lb.	.49
Magnesium, metallic, lb.	2.00-2.50
Nickel, electrolytic, lb.	.55
Cobalt, lb.	2.70
Cadmium, lb.	1.50
Quicksilver, flask	115.00
Silver, oz.	.80 3/4
Platinum, pure, oz.	105.00
Palladium, oz.	115.00
Tungsten, powder, 95 per cent, lb.	2.80

## Chemical Market

**COAL TAR PRODUCTS.**—While a majority of items under this classification remain in a position that generally favors the buyer, there has been nevertheless considerable activity noted during the past fortnight. The general opinion is that the market will react in favor of the seller with the advent of early fall.

**Benzol.**—This market has probably represented the weakest spot in the coal tar situation during the two weeks under review. Holders have expressed considerable disappointment with the situation but hope that a demand will shortly develop that will take care of the heavier offerings that have been noted of late.

**Aniline Oil.**—Values have been a trifle easier in this market but there has been no pronounced drop. There has been a fair domestic demand which has in a way taken care of the accumulated offerings. The export movement has been rather slow.

**Paranitraniline.**—The movement in this product has been slow and prices are not firm. Production is quite large. **Metanitraniline** in contrast is particularly scarce with practically no production. Preparation is being made however for new outputs.

**Toluol.**—While there has been some resale material on the market the position is firm and practically all producers are sold out for a lengthy period.

**T. N. T.**—The government has been buying all trinitrotoluol available and all plants equipped to produce the product have been working to capacity.

**Paratoluidine.**—There has been a strong and active inquiry noted for this intermediate. The *ortho*, however has moved somewhat slower. **Paranitrotoluol** is another product that has been in active request.

**Xylol.**—A sluggish market has been noted and pure has been sold at lower prices. Production is considerably in excess of demand.

**Solvent naphthas.**—While there has been a fairly good demand noted for this solvent there is a big production noted and prices are a shade easier.

**Cresylic Acid.**—A fair demand is noted for disinfectant purposes and there is also a movement noted to South America. The high duty prohibits imports from England except on order.

**Naphthalene.**—While there have been several large contracts placed during the interval the demand has not been general. Prices are about the same.

**Alpha Naphthylamine.**—Quietness prevails, and with the new producers offering prices are lower.

**Phenol.**—There has been very important business noted during the interval, one manufacturer selling 750,000 lb. in one day. Prices, however, have been shaded to meet buyers' views. The situation looks stronger.

**Dinitrophenol.**—The production is increasing noticeably and price shading has resulted in an effort to move stocks.

**HEAVY CHEMICALS.**—Summer dullness has prevailed, but there has been some special activity noted.

**Caustic Soda.**—An extremely firm tone has prevailed in this market. Manufacturers have sold up and business appears to be in the hands of resellers. Contracts have been in urgent request and there has been a big demand for 1918. All positions on caustic are higher. **Soda Ash.**—While the spot market is unchanged futures are higher, and there has been an active and urgent request for 1918 contracts. Speculative buying has been quite pronounced. **Acetate of soda** is pretty well under contract, but there have been no changes of consequence noted. **Bicarbonate of soda** has been in fair demand with prices higher, and some are sold up. **Silicate of soda** has been very strong, as the few producers are sold up. **Sulphide of soda** has been in very active demand for both domestic and export account, and the production is not keeping pace with the demand. **Bichromates** have been in fair demand, with supplies moderate and the market steady. **Bleaching powder** has been very weak, as is usual in the midsummer. Futures, however, are in better request.

## General Chemicals

WHOLESALE PRICES IN NEW YORK MARKET, AUG. 8, 1917

Acetic anhydride	lb.	1.90	—	2.00
Acetone, drums	lb.	.33	—	.35
Acid, acetic, 28 per cent	lb.	.05 1/4	—	.05 1/2
Acetic, 56 per cent	lb.	.11	—	.11 1/2
Acetic, glacial, 99 1/2 per cent, carboys	lb.	.36	—	.38
Boric, crystals	lb.	.13	—	.13 1/2
Citric, crystals	lb.	.72 1/2	—	.73
Hydrochloric, commercial, 18 deg	lb.	.01 1/4	—	.01 1/2
Hydrochloric, 20 deg	lb.	.02	—	.02 1/4
Hydrochloric, C. P., conc., 22 deg	lb.	.02 1/2	—	.02 3/4
Hydrofluoric, 30 per cent, in barrels	lb.	.04 1/2	—	.05
Lactic, 44 per cent	lb.	.11	—	.12
Lactic, 22 per cent	lb.	.04 1/2	—	.05
Nitric, 36 deg	lb.	.06 1/2	—	.06 3/4
Nitric, 42 deg	lb.	.08	—	.08 1/2
Oxalic, crystals	lb.	.46	—	.47
Phosphoric, 85 per cent	lb.	.33	—	.37
Picric	lb.	.70	—	.75
Pyrogallol, resublimed	lb.	3.50	—	4.00
Sulphuric, 60 deg	ton	24.00	—	26.00
Sulphuric, 66 deg	ton	34.00	—	36.00
Sulphuric, oleum (Fuming), tank cars	ton	45.00	—	50.00
Tannic, U. S. P., bulk	lb.	1.30	—	1.35
Tartaric, crystals	lb.	.78	—	.79
Tungstic, basis 100 per cent	lb.	1.80	—	—
Alcohol, grain, 188 proof	gal.	4.10	—	4.15
Alcohol, wood, 95 per cent	gal.	1.00	—	1.02
Alcohol, denatured, 180 proof	gal.	1.00	—	1.02
Alum, ammonia lump	lb.	.04 1/2	—	.05
Alum, chrome ammonium	lb.	.18	—	.20
Alum, chrome potassium	lb.	.35	—	.36
Alum, chrome sodium	lb.	.14	—	.15
Alum, potash lump	lb.	.07 1/2	—	.08
Aluminium sulphate, technical	lb.	.02	—	.02 1/2
Aluminium sulphate, iron free	lb.	.03 1/2	—	.03 3/4
Ammonia aqua, 24 deg. carboys	lb.	.12	—	.13
Ammonium carbonate	lb.	.13	—	.14
Ammonium nitrate	lb.	.16	—	.17
Ammonium sulphate domestic	100 lb.	6.80	—	6.90
Amyl acetate	gal.	4.50	—	4.60
Arsenic, white	lb.	.17	—	.18
Arsenic, red	lb.	.60	—	.65
Barium chloride	ton	85.00	—	90.00
Barium sulphate (Blanc Fixe, powder)	lb.	.04	—	.04 1/2
Barium nitrate	lb.	.11	—	.11 1/2
Barium peroxide, 80 per cent	lb.	.28	—	.30
Bleaching powder, 35 per cent chlorine	lb.	.01 1/4	—	.01 1/2
Borax, crystals, sacks	ton	.07 3/4	—	.08
Bromine, crude	ton	55.00	—	60.00
Bromine, technical	lb.	.80	—	.90
Calcium acetate, crude	per 100 lb.	5.25	—	5.30
Calcium carbide	ton	80.00	—	90.00
Calcium chloride, 70-75 per cent, fused, lump	ton	30.00	—	31.00
Calcium peroxide	lb.	1.30	—	1.65
Calcium phosphate	lb.	.30	—	.31
Calcium sulphate	lb.	.10	—	.12

Carbon bisulphide.....lb.	.06 <sup>1</sup> / <sub>2</sub>	.07
Carbon tetrachloride, drums.....lb.	.16 <sup>1</sup> / <sub>2</sub>	.16 <sup>3</sup> / <sub>4</sub>
Caustic potash, 88-92 per cent.....lb.	.85	.87
Caustic soda, 76 per cent.....lb.	.07 <sup>1</sup> / <sub>2</sub>	.07 <sup>3</sup> / <sub>4</sub>
Chlorine, liquid.....lb.	.15	.40
Cobalt oxide.....lb.	1.60	1.65
Copper.....100 lb.	1.00	1.05
Copper carbonate.....lb.	.32 <sup>1</sup> / <sub>2</sub>	.35
Copper cyanide.....lb.	.72	.74
Copper sulphate, 99 per cent, large crystals.....lb.	.09 <sup>1</sup> / <sub>4</sub>	.09 <sup>1</sup> / <sub>2</sub>
Cream of tartar, crystals.....lb.	.48 <sup>1</sup> / <sub>2</sub>	.50
Epsom salt, bags.....100 lb.	3.85	4.00
Formaldehyde, 40 per cent.....lb.	.17	.18
Glauber's salt.....100 lb.	.72	.80
Glycerine, bulk, C. P.....lb.	.63 <sup>1</sup> / <sub>2</sub>	.64
Iodine, resublimed.....lb.	4.25	
Iron oxide.....lb.	.02	.08
Lead, acetate, white crystals.....lb.	.16	.17
Lead arsenate.....lb.	.12 <sup>1</sup> / <sub>2</sub>	.13 <sup>1</sup> / <sub>2</sub>
Lead nitrate.....lb.	.17 <sup>1</sup> / <sub>2</sub>	.18
Litharge, American.....lb.	.08	.19
Lithium carbonate.....lb.	1.02	1.05
Manganese dioxide, U. S. P.....lb.	.48	.55
Magnesium carbonate, tech.....lb.	.13 <sup>1</sup> / <sub>2</sub>	.14
Nickel salt, single.....lb.	.11	.11 <sup>1</sup> / <sub>2</sub>
Nickel salt, double.....lb.	.08	.08 <sup>1</sup> / <sub>2</sub>
Phosphorus, red.....lb.	1.25	1.30
Phosphorus, yellow.....lb.	2.40	2.45
Potassium bichromate.....lb.	.37	.37 <sup>1</sup> / <sub>2</sub>
Potassium bromide granular.....lb.	1.35	1.40
Potassium carbonate calcined, 80-85 per cent.....lb.	.75	.78
Potassium chlorate, crystals.....lb.	.50	.55
Potassium cyanide, 98-99 per cent.....lb.	2.30	2.50
Potassium iodide.....lb.	2.90	2.92
Potassium murate 80-85 p. c. basis of 80 p. c.....ton	340.00	350.00
Potassium nitrate.....lb.	.31	.33
Potassium permanganate.....lb.	3.85	4.00
Potassium prussiate, red.....lb.	2.75	2.80
Potassium prussiate, yellow.....lb.	1.08	1.12
Potassium sulphate, 90-95 p. c. basis 90 p. c.....ton	325.00	350.00
Rochele salts.....lb.	.39	.39 <sup>1</sup> / <sub>2</sub>
Salt ammoniac, gray gran.....lb.	.10	.11
Salt ammoniac, white gran.....lb.	.15	.16
Salt soda.....100 lb.	1.20	1.25
Salt cake.....100 lb.	.95	1.05
Silver cyanide.....oz.		
Silver nitrate.....oz.	.49 <sup>1</sup> / <sub>2</sub>	.50 <sup>1</sup> / <sub>2</sub>
Soda ash, 58 per cent, light, flat.....100 lb.	2.85	3.00
Soda ash, 58 per cent, dense, flat.....100 lb.	3.75	4.00
Sodium acetate.....lb.	.09 <sup>1</sup> / <sub>2</sub>	.10
Sodium benzoate.....lb.	3.75	4.00
Sodium bicarbonate, domestic.....100 lb.	2.35	2.50
Sodium bicarbonate, English.....lb.		
Sodium bichromate.....lb.	.15 <sup>1</sup> / <sub>2</sub>	.16 <sup>1</sup> / <sub>2</sub>
Sodium bisulphite, powd.....lb.	.04	.04 <sup>1</sup> / <sub>2</sub>
Sodium chlorate.....lb.	.23	.25
Sodium cyanide.....lb.	.47	.50
Sodium fluoride, commercial.....lb.	.18	.18 <sup>1</sup> / <sub>2</sub>
Sodium hyposulphite.....lb.	.01 <sup>1</sup> / <sub>4</sub>	.02
Sodium nitrate, 95%.....100 lb.	4.27 <sup>1</sup> / <sub>2</sub>	4.30
Sodium nitrite.....lb.	.45	.50
Sodium peroxide.....lb.	.85	.90
Sodium phosphate (tri.).....lb.	.05	.05 <sup>1</sup> / <sub>2</sub>
Sodium prussiate, yellow.....lb.	.32	.33
Sodium silicate, liquid—40 deg. Baumé.....100 lb.	2.50	2.60
Sodium sulphide, 30 per cent crystals.....100 lb.	3.00	3.10
Sodium sulphide, 60 per cent, fused.....100 lb.	4.50	4.55
Sodium sulphite.....lb.	.03 <sup>1</sup> / <sub>4</sub>	.03 <sup>1</sup> / <sub>2</sub>
Strontium nitrate.....lb.	.28	.30
Sulphur chloride, drums.....lb.	.06	.06 <sup>1</sup> / <sub>2</sub>
Sulphur dioxide, liquid, in cylinders.....lb.	.15	.40
Sulphur, flowers, sublimed.....100 lb.	3.20	3.30
Sulphur, roll.....100 lb.	2.55	2.60
Sulphur, crude.....ton	45.00	50.00
Tin bichloride, 50 deg.....lb.	.19 <sup>1</sup> / <sub>4</sub>	.20
Tin oxide.....lb.	.64 <sup>1</sup> / <sub>2</sub>	.65
Zinc carbonate.....lb.	.25	.27
Zinc chloride.....lb.	.10 <sup>1</sup> / <sub>4</sub>	.11
Zinc cyanide.....lb.	.50	.55
Zinc dust, 350 mesh.....lb.	.17	.19
Zinc oxide, American process XX.....lb.	.14 <sup>1</sup> / <sub>4</sub>	.15
Zinc sulphate.....lb.	.05 <sup>1</sup> / <sub>2</sub>	.06

## Coal Tar Products (Crude)

Benzol, 90 per cent, water white.....gal.	.51	.55
Benzol, pure, water white.....gal.	.50	.52
Toluol, pure, water white.....gal.	1.70	1.90
Xylol, pure, water white.....gal.	.45	.50
Solvent naphtha, water white.....gal.	.18	.22
Solvent naphtha, crude, heavy.....gal.	.13	.16
Cresote oil, 25 per cent.....gal.	.31	.33
Dio oil, 20 per cent.....gal.	.29	.30
Pitch, various grades.....ton	8.00	20.00
Carbolic acid, crude, 95-97 per cent.....lb.	1.05	1.10
Carbolic acid, crude, 80 per cent.....lb.	.55	.60
Carbolic acid, crude, 28 per cent.....lb.	.32	.35
Cresol, U. S. P.....lb.	.25	

## Intermediates, Etc.

Alpha naphthylamin.....lb.	.75	.85
Aniline oil.....lb.	.28	.29
Aniline salts.....lb.	.33	.34
Anthrone, 80 per cent.....lb.	.10	
Benzaldehyde.....lb.	4.00	4.50
Benzidine, base.....lb.	1.85	2.00
Benzidine, sulphate.....lb.	1.55	1.60
Benzoic acid.....lb.	3.75	4.00
Benzyl chloride.....lb.	1.75	2.00
Beta naphthol benzoate.....lb.	8.50	9.00
Beta naphthol, sublimed.....lb.	.80	.85
Beta naphthylamin com.....lb.	2.50	
Dichlor benzol.....lb.	.11	.20
Dinitrochlorbenzol.....lb.	.44	.46
Dimethylaniline.....lb.	.58	.60
Diphenylamine.....lb.	1.00	1.05
H-acid.....lb.	3.25	3.50
Metaphenylenediamine.....lb.	1.75	1.80
Monochlorbenzol.....lb.	.22	.23

Naphthalene, flake.....lb.	.09	.09 <sup>1</sup> / <sub>4</sub>
Naphthionic acid, crude.....lb.	1.50	1.75
Nitro naphthalene.....lb.	.45	.50
Nitro toluol.....lb.	.50	.55
Ortho-aminodiphenol.....lb.		
Ortho-toluidine.....lb.	.90	1.00
Para-aminodiphenol, base.....lb.	4.75	5.50
Paranitraniline.....lb.	1.05	1.10
Paraphenylenediamine.....lb.	3.50	4.00
Para toluidine.....lb.	1.90	2.10
Phenol, U. S. P.....lb.	.40	.42
Resorcin, technical.....lb.	8.00	9.00
Resorcin, pure.....lb.	15.00	16.00
Salicylic acid.....lb.	1.50	1.75
Salol.....lb.	1.85	2.00
Sulphanilic acid.....lb.	.32	.33
Tolidin.....lb.	3.00	
Toluidine-mixture.....lb.	.75	.85

## Petroleum Oils

Crude (at the Wells)

Pennsylvania.....bbl.	3.10	
Cornwall, Ohio.....bbl.	2.40	
Somerset, Ky.....bbl.	2.20	
Wooter, Ohio.....bbl.	2.18	
Indiana.....bbl.	1.78	
Illinois.....bbl.	1.92	
Oklahoma and Kansas.....bbl.	1.85	
Caddo, La., light.....bbl.	1.90	
Corsicana, Tex., light.....bbl.	1.70	
California.....bbl.	.98	1.29
Gulf Coast.....bbl.	1.00	

## Lubricants

Black, reduced, 29 gravity, 25-30 cold test.....gal.	.13 <sup>1</sup> / <sub>2</sub>	.14
Cylinder, light.....gal.	.21	.26
Cylinder, dark.....gal.	.18	.19
Paraffine, high viscosity.....gal.	.29 <sup>1</sup> / <sub>2</sub>	.30
Paraffine, 3003 sp. gr.....gal.	.21 <sup>1</sup> / <sub>2</sub>	.22
Paraffine, 3605 sp. gr.....gal.	.18 <sup>1</sup> / <sub>2</sub>	.19

## Flotation Oils

(Prices at New York)

Pine oil, steam distilled, sp. gr. 0.925-0.940.....gal.	.52	
Pine oil, destructively distilled, sp. gr. 0.920-0.940.....gal.	.48	
Pine-tar oil, sp. gr. 1.025-1.035.....gal.	.25 <sup>1</sup> / <sub>2</sub>	
Pine-tar oil, double refined, sp. gr. 0.965-0.990.....gal.	.35	
Pine oil, light, sp. gr. 0.930, tank cars, f.o.b. works.....gal.	.37	
Pine oil, heavy, sp. gr. 1.025, tank cars, f.o.b. works.....gal.	.26	
Pine tar, thin, sp. gr. 1.060-1.080.....gal.	.22	
Turpentine, crude, sp. gr. 0.980-1.000.....gal.	.40	
Hardwood oil, f.o.b. Michigan, sp. gr. 0.960-0.990.....gal.	.19	
Hardwood oil, f.o.b. Michigan, sp. gr. 1.00-1.08.....gal.	.19	

## Vegetable and Other Oils

China wood oil.....lb.	.17	.19
Cottonseed oil, crude.....gal.	.96	.97
Linseed oil, raw, cars.....gal.	1.17	
Peanut oil, crude.....gal.	1.15	
Rosin oil, first run.....gal.	.35	
Rosin oil, fourth run.....gal.	.66	
Soya bean oil, Manchuria.....lb.	.12 <sup>3</sup> / <sub>4</sub>	.13 <sup>1</sup> / <sub>4</sub>
Turpentine, spirits.....gal.	.42	

## Miscellaneous Materials

Barytes, floated, white, foreign.....ton	38.00	40.00
Barytes, floated, white, domestic.....ton	28.00	32.00
Beeswax, white, pure.....lb.	.60	.65
Carnauba wax, flor.....lb.	.53	
Casein.....lb.	.19	.28
Chalk, light, precipitated, English.....lb.	.03	.06
Feldspar.....ton	8.00	12.00
Fuller's earth, powdered.....100 lb.	1.00	1.50
Osokerite, crude, brown.....lb.	.60	.70
Osokerite, American, refined, white.....lb.	.75	1.00
Red lead, dry, carloads.....lb.	.13	
Rosin, 280 lb.....bbl.	6.00	
Soapstone.....ton	10.00	12.50
Talc, American, white.....ton	10.00	13.00
White lead, dry.....lb.	.11 <sup>1</sup> / <sub>2</sub>	

## Refractories, Etc.

(F.O.B. Works)

Chrome brick.....net ton		Nominal
Chrome cement, Grecian.....net ton		Nominal
Clay brick 1st quality fireclay.....per 1000	45.00	50.00
Clay brick, second quality.....per 1000	30.00	
Magnesite, raw.....ton	30.00	35.00
Magnesite, calcined.....ton	40.00	55.00
Magnesite, Grecian, dead burned.....net ton	90.00	
Magnesia brick, Grecian, 9x4 <sup>1</sup> / <sub>2</sub> x2 <sup>1</sup> / <sub>2</sub> .....net ton	140.00	
Silica brick.....per 1000	50.00	

## Ferroalloys

Ferrocobaltitium, 15-18 per cent, car loads, f.o.b. Niagara Falls, N. Y.....ton	160.00	
Ferrochromium.....lb.	.20	
Ferromanganese, domestic, delivered.....ton	375.00	400.00
Ferromanganese, English.....ton	375.00	
Ferromolybdenum, per lb. of Mo.....lb.	4.00	4.40
Ferrosilicon, 50 per cent, carloads, del., Pittsburgh.....ton	200.00	225.00
Ferrosilicon, 50 per cent, contract.....ton	100.00	
Ferrotungsten, 75-85 per cent, f.o.b. Pittsburgh.....lb.	2.95	
Ferrovandium, f.o.b. works, per lb. of U.....lb.	7.00	
Ferrovandium, f.o.b. works.....lb.	3.25	3.50

## Ores and Semi-finished Products

Molybdenite, per lb. of MoS <sub>2</sub> .....lb.	2.10	
Tungsten, Scheelite, per unit of WO <sub>3</sub> .....ton	26.00	
Tungsten, Wolframite, per unit of WO <sub>3</sub> .....ton	25.00	
Uranium oxide, 96%.....lb.	3.50	
Vanadium Pentoxide, 99%.....lb.	11.00	

# INDUSTRIAL

## Financial, Construction and Manufacturers' News

### Financial New Companies

The All-Steel Wheel Company, Philadelphia, Pa., has filed articles of incorporation under Delaware laws with a capital of \$200,000 to manufacture steel wheels. F. R. Hansell, Philadelphia; J. V. Pimm, and S. C. Seymour, Camden, N. J., are the incorporators.

The American Alcolene Corp., Dover, Del., \$20,000,000. To deal in all liquids of all kinds, including petroleum.

The American Iron & Furnace Company, Clinton, Iowa, has been incorporated in Delaware with capital of \$150,000 to operate an iron furnace and smelting plant. J. E. Moran, F. A. Hohenschuh, T. S. Peterson, Jr., and C. J. Metzger, all of Clinton, are the incorporators.

The American Marbelite Company, Dover, Del., has been incorporated with a capital of \$5,000,000 to manufacture composition specialties of vitreous materials. H. L. Mullin, C. L. Rimlinger and Clement M. Egner, Wilmington, are the incorporators.

The American Mine & Torpedo Company, East Orange, N. J., has been incorporated with a capital of \$100,000 to manufacture mines and munitions. Gordon Grand, L. Matthews and H. H. Picking, all of East Orange, are the incorporators.

The American Petroleum Co., Baltimore, Md., \$1,500,000. To deal in petroleum and its products. The incorporators are Matthew Gault, Harold Tschudi and William D. MacMillan.

The Belleville Metal & Chemical Co., Belleville, N. J., has been incorporated with a capital of \$50,000 to manufacture chemicals. Charles and Jacob Bobker and David Silver are the incorporators.

The Berkshire Rubber Company of New York, Inc., Albany, N. Y., has been incorporated with a capital of \$10,000 to manufacture rubber goods. T. D. McMurray and A. and B. Wurts, all of Albany, are the incorporators.

The Black Diamond Oil Company, a \$25,000,000 corporation, which was recently organized by prominent Western and Eastern capitalists, has been quietly financing and accumulating valuable oil proven and producing acreage in Kentucky, Mississippi, Michigan, Wyoming, Oklahoma, Indiana and the Coastal Oil Belt of Texas. The following companies will be merged under the Black Diamond banner, either by direct purchase or control of stock: The Alcock Oil Company, Rising Sun Oil Company, Thayer Oil & Gas Company, Wyoming Producing & Refining Company and the Monticello Oil & Gas Company. The holdings of this merger are approximately 800,000 acres, over half of which is owned in fee. Some of the men associated in the deal are C. C. Marshall, Drumright, Okla.; B. M. Robinson, Joplin, Mo.; J. W. Mettler, Chicago; Marion W. Edwards, Casper, Wyo.; E. C. Lott, Chicago; J. D. Cameron, New York; R. H. Owen, Chicago; James A. Wallace, Irvine, Ky.; F. M. Smith, St. Louis; Morris M. Becher, New York; F. W. Church, Jefferson City, Mo.; W. A. Otto, Chicago; L. C. Moch, Casper, Wyo.; Hon. J. M. Hayes, Oklahoma City; Edward Hilp, Louisville; O. A. Kintz and A. C. McClaughry, Chicago.

Briggs & Co., Inc., Providence, R. I.; \$5,000. To do a chemical manufacturing business. Incorporators: Annie M. Briggs, Frances A. Rieckel and Willard M. Dean.

The Brooklyn Standard Laboratory, Brooklyn, N. Y., has been incorporated with a capital of \$10,000 to manufacture chemicals. P. F. Lahm, P. W. Schumacher and L. Schopfer, 213 Cornelia Street, Brooklyn, are the incorporators.

The Carr Leather Company, Dover, Del., \$120,000. To manufacture leather.

The Columbia Fuller's Earth Company, Kettle Falls, Wash., has been incorporated for \$30,000, with headquarters in this city. Incorporators are Henry Severin, Herman N. Zapel, Edward Severin and Raymond Zapel, and company will develop a large deposit of Fullers earth near Kettle Falls.

Conewago Chemical Co., Warren, Pa., \$75,000. W. G. Heasley, incorporator.

Cosden & Co., Wilmington, Del., \$32,000,000. To produce and prepare for market petroleum and natural gas in all forms.

The Diarsenol Company, Inc., Buffalo, N. Y., has been incorporated with a capital of \$25,000 to manufacture chemicals. G. A. Webster, A. E. Jones and J. J. Henry, Buffalo, are the incorporators.

Dixie Foundry Co., Cleveland, Ohio, \$40,000. To engage in the general foundry business. Incorporators: S. B. Rymer, J. P. O'Neill, J. S. O'Neal, P. B. Mayfield, Chas. S. Mayfield.

Durst Products Company of America, Delaware; \$250,000. To deal in oil and natural gas. Incorporators are C. L. Rimlinger, H. C. Mullin, Clement M. Egner, Elkton, Md.

Franklin Founders Corporation, Delaware; \$2,000,000. To conduct a general foundry business. Incorporators: F. D. Buck, M. L. Harty, K. E. Longfield, Wilmington, Del.

General Refining Co., Delaware; \$750,000. To acquire oil lands and market products of same. Incorporators are Arthur W. Britton, Samuel B. Howard, Louis H. Gunther, New York City.

The Helkulin Chemical Co., 929 Madison Street, Hoboken, N. J.; \$7,000. To deal in all kinds of dyestuffs. Incorporators are R. Helwig, C. W. Kuhle, M. Lingren.

High Gravity Oil Co., Delaware, \$3,000,000. To drill and market oils. Incorporators: H. I. Mullin, Clement M. Egner.

Indiana Window Glass Co., Vincennes, Ind.; \$100,000. To manufacture, buy and sell window glass. Incorporators: F. Bastian, J. A. Sweet, L. A. Meyer and Anton Simon.

Industrial Electric Furnace Co., Indianapolis, Ind.; \$500,000. Incorporators: Chas. B. Sommers, Chas. B. Fletcher, F. von Schieggell, F. T. Snyder and S. A. Fletcher. The company will operate its factory in Indianapolis for the manufacture of electric furnaces. The main offices will be in Chicago.

International Sisal & Petroleum Co., New York; capital, \$1,000,000. To acquire lands suitable for growing agave, hemp, flax, etc.

The Iron & Ore Corporation of America, New York, has been incorporated with a capital of \$250,000 to engage in the production of iron, steel and other metals. V. E. Seipgens, A. R. Ely and J. M. Lowenstein, 11 West Ninetieth Street, are the incorporators.

The Legelm Rubber Company, Jersey City, N. J., has filed articles of incorporation with a capital of \$25,000 to manufacture rubber goods of various kinds. F. Losche, A. McMahon and C. B. Hermans, Jersey City, are the incorporators.

The McKeesport Enameling Company, McKeesport, Pa., has been incorporated in Delaware with a capital of \$50,000 to manufacture paints and varnishes. A. Clifford Wiltshire, J. R. Woreley and James W. Nesbitt, McKeesport, are the incorporators.

The Machine Composition Company, Philadelphia, Pa., has filed articles of incorporation with a capital of \$18,000 to manufacture printing type. B. F. Banes is the principal incorporator.

Merry Oil & Refining Co., Delaware; \$1,000,000. To acquire oil lands and develop the same. Incorporators are E. L. Merry, R. A. Moody and L. Harden.

Mitchell Chemical Co., Altoona, Pa., \$5,000. W. R. Merrill, incorporator.

Monitor Oil & Refining Co., Delaware; \$1,000,000. To acquire and develop oil lands of all kinds. The incorporators are Walter P. Carrow, George T. Maxwell, Local Dover.

The National Synthetic Rubber & Tire Company, New York, has been incorporated in Delaware with a capital of \$1,000,000 to manufacture tires and other rubber goods. Arthur W. Britton, S. B. Howard and John A. Moore, New York, are the incorporators.

The National Tractor Company, Georgetown, Del., has filed articles of incorporation with a capital of \$2,500,000 to manufacture tractors and parts. C. W. Cullen, Albert Worth and W. Martin, all of Georgetown, are the incorporators.

The Nichols-Vogt Chemical Company, Buffalo, N. Y., has been incorporated with a capital of \$25,000 to manufacture chemicals. Charles J. and Dayton G. Vogt, and Walter C. Nichols, all of Buffalo, are the incorporators.

The Nitrogen Fixation Corporation, New York, has filed articles of incorporation with a capital of \$1,000,000 to manufacture chemicals and allied products. The incorporators are J. R. Rubin, J. F. A. Comstedt and S. M. Weil, 34 Pine Street.

The Penn York Gas & Oil Co., Batavia, N. Y.; \$1,000,000.

Pittsburgh-Illinois Oil & Gas Co., Pittsburgh, Pa.; \$100,000. W. A. McCoy, Geo. W. Morgan, W. I. N. Lofland.

The Pittsburgh Mining Machine Company, Pittsburgh, Pa., has filed articles of incorporation with capital of \$100,000 to manufacture mining machinery. T. H. Edelblute heads the company.

The Procaline Company, Inc., New York, has filed articles of incorporation with a capital of \$10,000 to manufacture chemicals. J. E. Vidal, R. G. Contrell and P. L. McIlvaine, 257 West 136th Street, are the incorporators.

The Progressive Machine & Metal Products Company, New York, has been incorporated with a capital of \$10,000 to manufacture boilers, machinery, etc. A. Kipness and L. Olitsky, 1517 Fifty-third Street, are the incorporators.

Protection Paint Co., Inc., Brooklyn, N. Y.; \$10,000. General manufacturing and sale of paint, varnishes, chemicals. Incorporators are J. Karjan, M. Bartholomew, P. Lamperopoulos, 66 Fifth Avenue, Brooklyn.

The Pyrohodol & Chemical Co., Inc., Chicago, Ill.; \$15,000. Incorporators are Samuel M. Come, H. Weintraub, Alfred Weissenbach.

Santa Rita Fuel & Iron Co., St. Louis, Mo.; \$500,000.

The Seneca Electric Furnace Corporation of Albany, N. Y., has been incorporated for the purpose of manufacturing and selling electric furnaces for steel making and other purposes. Thornton W. Price is vice-president and general manager and Edwin Corning is treasurer. The New York office of the company is located in the Woolworth Building.

Smelter Steel Co., Seattle, Wash.; \$1,500,000. Corwin S. Shank, incorporator.

Sussex Iron & Steel Co., New York; \$1,000,000. To manufacture and sell and deal in and with steel, copper, nickel, etc.

Tennessee Manganese Co., Wilmington, Del.; \$300,000. To manufacture iron, steel, etc.

The Thermit Welding & Modern Torch Company, Seattle, has been incorporated for \$4,000 by T. A. Errett, R. A. Redman, et al. Concern will establish a welding plant in Seattle.

The United Steel & Metal Corporation, New York, has been incorporated with a capital of \$100,000 to engage in the manufacture of iron, steel and other metal products. A. Heller, F. Viethardt and M. Sternberg, 906 Broadway, are the incorporators.

Washburn Wire Company, Madison, N. J.; \$11,000,000. To manufacture iron, steel, copper and other metals.

The Watts Tool & Machine Company, Turtle Creek, near East Pittsburgh, Pa., has been incorporated with a capital of \$100,000 to operate a local works. C. J. Watts, Turtle Creek, is the principal incorporator.

The Wearwell Gasket & Packing Company, Camden, N. J., has been incorporated with a capital of \$25,000 to manufacture rubber packing and kindred specialties. Joseph A. Whitney, Eleventh and Linden Streets; John K. Stevenson and James V. Waring, Camden, are the incorporators.

### Capital Increases

The Haloid Company, Rochester, N. Y., has increased its capital from \$75,000 to \$150,000. The company specializes in the production of photographic papers.

The Western Utah Extension Copper Company, Pittsburgh, Pa., has increased its capital from \$1,500,000 to \$2,500,000 for expansion.

The Champion Paper Company, Watertown, N. Y., has increased its capital from \$100,000 to \$500,000.

The More-Jonas Glass Company, Bridgeport, N. J., has increased its capital from \$100,000 to \$250,000 for expansion. The company specializes in the manufacture of bottles and jars.

## Construction and Operation

### California

**MARTINEZ.**—Preparations are being made by the Shell Oil Company to begin the \$1,000,000 worth of new work on its plant here, including construction of 55,000 barrel steel tanks, for which a contract has been let.

**OAKLAND.**—The new open-hearth furnaces at the Judson works were started early in July. W. D. Bunker has been made general manager of the entire Judson Company, with charge of both the Emeryville and the San Francisco plants. Mr. Bunker has already begun the work of reconstruction. General plans have been made that will involve an ultimate expenditure of a quarter of a million dollars. The next move that will be made in this reconstruction plan will be the wrecking of the old rolling mill and the construction of a modern steel structure with hollow tile walls. This will cost about \$40,000. When this is finished, a complete equipment of traveling cranes will be installed. This will be followed by other reconstruction until the old plant has been entirely demolished and an entirely new Judson works has arisen at Emeryville.

**RED BLUFF.**—Tehama County is fast forging to the front as one of the greatest chrome producers in the State. For 15 or 20 miles along the coast range of mountains in Tehama County chrome ore crops out at intervals of two or three hundred feet. At the present time this industry is receiving more attention by outside capital than any other metal mined in the north. Already numerous big properties are being developed and at the present time there are three companies shipping ore.

**RICHMOND.**—E. A. Maas and his associates of Philadelphia and Los Angeles will erect a carbon factory here, which will cost \$500,000. Work on the factory will start at once. This is the third carbon plant to locate here, the reason being that much of the material used comes from the Standard Oil refinery.

**SAN FRANCISCO.**—Byron Jackson Iron Works of San Francisco, Cal., are erecting a new \$100,000 machine shop at their plant at West Berkeley. The new shop will be ready for occupancy about Nov. 1.

### Idaho

**BOISE.**—The American Nitrate Company is investigating some sodium and potassium nitrate properties in eastern Oregon, in Lake and Harney counties. A. E. Robinson is superintendent in charge of work. C. R. Cole, Marquette Building, Chicago, is interested.

**KELLOGG.**—The Bunker Hill & Sullivan smelter was blown in recently, one of the three furnaces being started, the charge consisting of Caledonia ore. The smelter, it is said, is one of the most complete and modern in the world. It cost about \$1,000,000. It has been so constructed that it may be enlarged from time to time as the demands make necessary. The first improvement to be constructed will be an electrolytic zinc plant, this having been recently decided upon.

### Illinois

**FEDERAL.**—The Consolidated Chemical Products Company will erect a plant at Federal, just east of Alton, Ill., for the manufacture of salts of zinc and barium.

### Indiana

**WINCHESTER.**—The Woodbury glass factory, which was destroyed by fire at a loss of at least \$115,000, will resume operations not later than November 1. This announcement was made following a meeting of the board of directors. The factory will be operated on a much larger scale, and will include more territory.

### Kansas

**WICHITA.**—L. C. Hill, president of the Nith Chemical Company of Lawrence, Kan., was recently here looking for a location for a branch plant. The company manufactures medicinal products.

### Louisiana

**MONROE.**—Edwin E. Binney and other New York capitalists plan the construction of a large carbon plant at Fairbanks City, which will cost \$200,000. They have recently purchased an oil and gas lease from the Great Southern Oil Company.

### Maryland

**BALTIMORE.**—The Black & Decker Mfg. Company, 105 South Calvert Street, manufacturer of air compressors, electric drills, etc., has awarded a contract for the construction of a new one-story shop, 60 x 200 ft., at Towson. The Cowan Building Company, 106 Madison Street, Baltimore, is the contractor.

**BALTIMORE.**—The Maryland Brass & Metal Works has awarded a contract to the Price Concrete Construction Company, Maryland Trust Building, for the construction of the proposed new two-story addition to its plant on Guilford Avenue, 46 x 90 ft., to cost \$12,000.

### Minnesota

**MINNEAPOLIS.**—A new chemical plant to manufacture tri-sodium phosphate will be located here in the fall. The new company is incorporated with a capital of \$150,000. Other chemicals which will be made include di-sodium phosphate, phosphoric acid and caustic soda.

### Nevada

**AUSTIN.**—The Nevada Austin Mines Company, located at Newpass, twenty-five miles from Austin, will construct a 75-ton cyanide plant for handling of ores. Douglas Muir, metallurgical engineer, has been engaged to draw the plans and superintend the construction of the plant.

### New Jersey

**CAMDEN.**—The Active Chemical Company has removed its works from 1210 Kalign Avenue to a new plant at Ferry and Atlantic Avenues, to provide for increased operations. The company has recently acquired a site of about twenty acres at Mount Ephraim, and expects to commence the erection of a new plant early in 1918. Dr. Edward Kressel, president.

**HARRISON.**—The Driver-Harris Company of Harrison has filed plans for a foundry in Middlesex Street and Railroad Avenue, to cost \$25,000.

**HARRISON.**—The Crucible Steel Company, South Fourth Street, has awarded contracts to the American Bridge Company for structural steel for additions to its plant, to cost about \$75,000.

**MAURER.**—The American Smelting & Refining Company has awarded a contract for the erection of a new four-story steel pulverizing mill, 55 x 60 ft., to the H. D. Best & Company, 52 Vanderbilt Avenue, New York.

**METUCHEN.**—The Acme Dyeing & Chemical Company is planning for the erection of an addition to its plant. Charles B. Carman, 406 Main Street, is engineer.

**NEWARK.**—Fire, July 21, destroyed a portion of the plant of the Cotex Company, 341 Oliver Street, manufacturer of artificial leather, with loss estimated at \$10,000.

**NEWARK.**—Fire, Aug. 2, destroyed the plant of the Roxylite Company, Long Avenue, Hillside district, consisting of about twenty buildings, with loss estimated at \$100,000. The plant will be rebuilt. The company specializes in the manufacture of film for motion picture service.

**NEWARK.**—The Balbach Smelting & Refining Company, Doremus Avenue and Avenue R, will build a new one-story retort furnace at its works.

**NEWARK.**—The Butterworth-Judson Corporation will build three large one-story extensions to its chemical works on Avenue R, to cost \$152,000. Two of the structures will be 140 x 300 ft., and the other, 60 x 445 ft.

**NEW BRUNSWICK.**—The United States Nickel Company, Allen Avenue, is planning for the construction of an addition to its main plant.

**PARLIN.**—The E. I. du Pont de Nemours Company has commenced the erection of an addition to its plant for the manufacture of smokeless powder.

**ROOSEVELT.**—The Tyson Rubber Substitute Company has had plans prepared for the erection of a new plant at Woodbridge.

**TRENTON.**—The Utah Potash Company, capitalized at \$1,500,000, plans the early operation of its new \$100,000 plant here. The building is equipped to handle various chemical products.

### New York

**BALDWINVILLE.**—The Hoffman Paper Company has acquired property on Oswego Street, to be used as an extension to its works.

**BROOKLYN.**—The Bristol Myers Company, 277 Greene Avenue, manufacturer of chemicals, will build a new one-story plant, 100 x 200 ft., in the Hillside district, near Newark, N. J., to cost about \$25,000. Contract for erection has been awarded.

**BROOKLYN.**—The Chelsea Fibre Mills, 1155 Manhattan Avenue, has awarded a contract for the construction of a two-story brick addition to its plant, 80 x 200 ft., at Manhattan Avenue and Newtown Creek. The Tidewater Building Company, 16 East Thirty-third Street, New York, is the contractor.

**BUFFALO.**—The Curtiss Aeroplane Company has had plans prepared for a new three-story brick and steel plant to cost about \$400,000, to be erected at 1992-2160 Elmwood Avenue.

**BUFFALO.**—The Wickwire Steel Company is planning for the early operation of its new rod and blooming mill, now nearing completion.

**FULTON.**—The Arrowhead Mills, Inc., manufacturer of paper, has had plans prepared for a new two-story paper mill, about 80 x 350 ft., to cost \$350,000.

**NEW YORK.**—The General Optical Company, 533 First Avenue, has awarded a contract to A. Barbarelli, 48 South Fourth Avenue, Mt. Vernon, for the erection of a new three-story brick addition, 75 x 275 ft., at First Avenue and Washington Street, Mt. Vernon, N. Y.

**NEW YORK.**—C. K. Williams & Company, Easton, Pa., have purchased the plant of the Union Carriage & Gear Company for \$25,000, and will immediately begin alteration and installation of equipment for the manufacture of rosin size and other paper mill chemicals. Other plants operated by C. K. Williams & Company are located at Kalamazoo, Mich., Holyoke, Mass., Allentown, Pa., Ontario, N. Y., South Carolina and Florida.

**SCHENECTADY.**—The General Electric Company is planning for the immediate erection of a new one-story foundry, 100 x 110 ft., at its Pittsfield, Mass., works.

**SYRACUSE.**—The Onondaga Pottery Company, West Fayette Street, is making rapid progress in the erection of new buildings at its plant to form a complete additional unit for manufacturing. Five buildings will be constructed, one four-story, 40 x 130 ft.; two four-story, 40 x 90 ft.; one two-story, 40 x 90 ft.; and one one-story, 40 x 90 ft. It is expected to have the main section of the new extension ready for occupancy in the fall. E. L. Torbert is general manager.

**TICONDEROGA.**—The Ticonderoga Pulp & Paper Company, North Main Street, will build a one-story, reinforced-concrete addition to its plant, 50 x 150 ft., to cost about \$15,000.

### Ohio

**COLUMBUS.**—The Federal Chemical Company has completed its plant in Bonham Avenue, and is ready to occupy the buildings, which cover three acres of the 15 acres in the tract owned by the company. The company will employ 100 persons.

**ELYRIA.**—The Harshaw-Fuller-Goodwin Company will erect an addition to its plant at a cost of \$10,000.

**LORAIN.**—National Tube Company plans the erection of a benzol plant at this place. Benzol will be made from the 308 by-product coke ovens at the plant.

**YOUNGSTOWN.**—Extensions of a substantial nature will be made to the plant of the Youngstown Iron & Steel Company, controlled by the Sharon Steel Hoop Company of Sharon, Pa. Plans are rapidly being formulated for these improvements. Two or three open-hearth furnaces will be added, as well as extensions to the finishing departments. Definite plans for these additions will be completed within a very short time. The improvements have been under consideration ever since the Sharon concern acquired the local property. The Sharon Steel Hoop is capitalized at \$10,000,000, and it is said to have sufficient capital and other funds available to finance the improvements. They will involve a large outlay and will mean the employment of many more workmen.

**YOUNGSTOWN.**—Improvements involving the expenditure of \$3,000,000 were announced recently by James A. Campbell, president of the Youngstown Sheet & Tube Company. One hundred and two additional by-product coke ovens will be built. The tar products and benzol plant will be increased 50 per cent. The company now has 204 coke ovens, and the additional ones will increase the capacity of this department 50 per cent.

## Oklahoma

**SAND SPRINGS.**—The Mohawk Refining Company will establish another oil refinery, with a capacity of 2000 barrels daily.

## Pennsylvania

**CHESTER.**—The Chester Paper Company will erect a new three-story and basement building, about 155 x 356 ft., at its plant, to be used as a finishing works. The structure will cost about \$200,000. The Scott Paper Company, Glenwood Avenue, Philadelphia, operates this company.

**LANSDALE.**—The Barrows Mfg. Company, manufacturer of rope, cordage and kindred products, has commenced the construction of a new building to be used as a rope manufacturing plant, replacing the structure recently destroyed by fire.

**NAZARETH.**—The Nazareth Foundry & Machine Company, manufacturer of iron and steel castings and shapes, has been acquired by new interests for a consideration of about \$100,000. The new owners are said to be planning to increase the capacity of the works.

**PHILADELPHIA.**—The Gorgas-Pierle Mfg. Company, 130 East Allen Street, manufacturer of oils of different kinds, will build a five-story brick and concrete addition to its plant, 75 x 155 ft., at 144-64 East Allen Street, to cost about \$100,000. The Turner Concrete Steel Company, 1715 Sansom Street, has the contract for erection.

**PHILADELPHIA.**—Dungan Hood & Company, Inc., American Street, manufacturer of tanned, curried and finished leathers, has acquired a five-story factory at American and Diamond Streets, to be used for plant extensions.

**PHILADELPHIA.**—Fire, July 25, destroyed a portion of the oil works of the American Refining Company, Point Breeze, with loss estimated at \$400,000. The plant will be immediately rebuilt. J. H. Van Dyke is president.

**PHILADELPHIA.**—Charles Lennig & Company, 112 South Front Street, will build a two-story, brick and steel addition, about 40 x 50 ft., to their chemical plant at Richmond Street and Delaware Avenue, to cost about \$11,000.

**PHILADELPHIA.**—The Penn Paper Products Company, recently incorporated, has filed notice of organization at Camden, N. J., to operate its proposed plant in that city. LeRoy Jacobs, Philadelphia; and Cyrus E. Tomlinson, McKinley, Pa., head the company, which has an authorized capital of \$50,000.

**PHILADELPHIA.**—The Barrett Mfg. Company, manufacturer of chemicals, has awarded a contract to the A. Raymond Raff Company, 1635 Thompson Street, for the construction of a one-story, concrete and brick addition, 87 x 107 ft., at Bermuda and Margaretta Streets, to cost \$40,000.

**PITTSBURGH.**—The Pittsburgh Steel Products Company is planning a new plant, including a new town on Monongahela River. It is planned to expend about \$3,000,000. Several farms in Allen township, opposite Fayette City, were purchased some time ago. A battery of blast furnaces, tube mills and other departments will be installed. The plant will have a river frontage of three miles. The president of the company is Willis F. McCook of Pittsburgh.

**READING.**—The Republic Color & Chemical Company, operating a number of plants in New England, will erect a factory here. The factory will include five buildings. John D. Esterly of Reading heads the company.

**ST. MARYS.**—The recent demand for electric furnace electrodes has come to the attention of the Stackpole Carbon Company at St. Marys, Pa., and their production department, after making many experiments, has developed a carbon graphite electrode, called "Stackpole Special," which has a high current-carrying capacity, and is being introduced extensively throughout the industries employing electric furnaces. The great demand for ordinary and special electrodes has brought about an intense demand for electrodes, and with the intention of meeting this demand the Stackpole Carbon Company has completed a large unit to their big plant, with the object of coming to the aid of the many who must have electrodes to operate. This new plant is equipped with machinery and furnaces to handle all sizes, both square and round, up to and including 17 inches in diameter.

At present the concern is daily producing large quantities of 4, 5 and 6-in. diameter electrodes. These are being made up of a composition which they have found offers a close substitute for graphite as regards the interchange of sizes, and it is interesting to note that these electrodes of a carbon

graphite composition are being used in the place of graphite. The comparative diameters of the "Stackpole Special" electrode to the graphite is working successfully at 6 to 4, which fact is of engineering interest in view of the fact that so much smaller sizes as compared with the old carbon electrode can be used in the place of graphite. This ratio of diameters, when used, has given quicker heats with the same power consumption per ton in the case of the "Stackpole Special" than with the graphite, and confirms the production department's views that they have eventually solved the problem of the sort of electrode which will take care of the present shortage without resorting to the use of the old huge size carbon electrodes and consequent redesign of hundreds of electric furnaces.

## Tennessee

**BRISTOL.**—Manufacturing will begin immediately in the new plant of the Chas. A. Schieren Company of New York City, built as an addition to its tannery at Bristol, Tenn. The buildings are entirely completed, and the equipment of machinery is being installed for the manufacture of the highest grade machine belts, the greater portion of which will be shipped to Southern plants. A working force sufficient to produce 24,000 lineal feet of belting daily will be employed at the start, and gradually added to, as skilled help can be secured, until the full capacity of the plant, 50,000 feet daily, is reached.

## Texas

**DENISON.**—Construction work has begun on the mill and warehouses of the Peters Oil & Refining Company, to manufacture oil from peanuts. The mill building proper will be constructed of steel and brick, and will be 40 x 70 ft. The warehouses will be much larger than the mill, and will have a capacity of several hundred carloads of peanuts. The storage of peanuts will be large enough to insure operation of the plant throughout the year. The company, which was recently organized, will specialize in milling peanuts, beans and other vegetable products.

## Utah

**GUNNISON.**—The Gunnison Valley Sugar Company is planning the erection of a sugar factory in this valley. It will have a capacity of 600 tons, and will be completed in time for the next year's crop. The company was recently organized, and is capitalized at \$1,325,000. The officers are as follows: President, W. O. Kay; secretary, I. C. Thoreson, United States surveyor general for Utah; treasurer, W. H. Swanson, president of the Swanson Theater Circuit; additional directors, James P. Sprunt, Dr. A. C. Wherry, W. M. Johnson and Max Aniels. All of the officers are of Salt Lake.

**SALT LAKE CITY.**—Thomas B. Keeley of Chicago, who has a large number of patented iron ore claims in Iron County, and who owns 2100 acres of coal in the vicinity of Sunnyside, recently made an inspection of the properties and consulted with his engineers in regard to the advisability of erecting a steel plant near the Salt Lake City limits or on the shores of Utah Lake.

## Virginia

**IVANHOE.**—The National Carbide Corporation of Bluefield, W. Va., will erect a plant here that will have an annual production of 15,000 tons of carbide. The plant will be built immediately, and will be completed within six months.

## Washington

**CENTRALIA.**—R. Thomas of Portland, president of the Thomas Pulp & Paper Company, a \$5,000,000 corporation just formed, announced that his company has completed arrangements for the erection of a 40,000 horse power plant and paper mill in Aberdeen. A new process of making all kinds of paper out of red fir has been invented by Mr. Thomas. The power plant will be located here. He says his company has purchased 300 acres of coal land in South Hanaford Valley and will mine its own coal, 500 tons of which will be needed daily.

**SEATTLE.**—A new corporation with a capital of \$20,000,000 for building iron ore smelters, steel mills and blast furnaces on Lake Washington near Seattle, has been organized in San Francisco. It is possible that some of the iron ore will be obtained from Stevens County, northern Idaho and British Columbia. Some of the men interested are well known in Spokane, among them being William H. Crocker of San Francisco, who is interested with R. S. Talbot of Spokane in magnesite operations

in Stevens County. Others who are said to be in the new organization are D. C. Jackling, William G. Devereaux, D. P. Hoak, S. F. B. Morse, B. L. Thane of San Francisco, and William Pigott of Seattle. Smelters, blast furnaces and steel mills will be built at Seattle, where the new company has 500 acres. The Pacific Improvement Company already has been given contracts for coal to be secured in Washington and which is said to be of a high coking quality. Gas ammonia, tar and other by-products will be manufactured.

## Wisconsin

**RACINE.**—The Racine Rubber Company is building extensions to its works to increase the present capacity for the manufacture of automobile tires.

## Canada

**SUDBURY, ONT.**—An enormous nickel smelter and refining plant will be constructed by the British-American Nickel Corporation about 4½ miles northwest of Sudbury. A large amount of Toronto capital will be invested in the new concern, though the British government controls \$14,000,000 of the \$20,000,000. It is estimated that within two years the corporation will be able to produce 6000 tons of refined nickel annually, and according to a statement made by E. P. Mathewson, general manager, the entire output is to go to the British government, the International Nickel Company being at the present time its chief source of supply.

## Manufacturers' Notes

**THE BYRON JACKSON IRON WORKS,** San Francisco, Cal., has moved its general offices from 357 Market Street to the Sharon Building, on New Montgomery Street, directly opposite the Palace Hotel.

**ELECTRIC HOISTS.**—The Link-Belt Company, with factories in Chicago, Philadelphia and Indianapolis, and sales offices in the principal cities of the country, announces its ability to again furnish Link-Belt Mono-rail electric hoists for quick shipment. These machines are made at the Philadelphia plant, where a large additional building is rapidly nearing completion and the present manufacturing facilities are being greatly increased. Both types, C-1 and C-2, can be furnished, the safe lifting capacities ranging from 1000 lb. to 6000 lb. They can be adapted for either direct or alternating current and fitted with plain, hand-gear, cord-operated motor, or a cage operated motor trolley.

**FEDERAL TRADE COMMISSION'S COPPER COST INVESTIGATION NEARING COMPLETION.**—The Federal Trade Commission's investigation into the cost of producing copper, under supervision of Commissioner Colver, is progressing favorably. Dr. L. H. Haney is in direct charge of the details of this phase of the commission's investigation of metal costs. The field reports are now coming in rapidly and the commission hopes to have all reports in and results ready for submittal to the President within another week. None of these figures will be given out at the commission. If given out at all they will be made public at the White House.

**THE GLENS FALLS MACHINE WORKS,** which have been making a successful sulphur burner at Glens Falls, N. Y., have consolidated with the F. R. Patch Manufacturing Co., Rutland, Vt. The business of the Glens Falls concern will be carried on under the old name, the offices remaining at Glens Falls, except the treasurer's office, which will be at Rutland. The officers are: President, F. R. Patch; vice-president, Newman K. Chaffee; treasurer, George C. Cobb; secretary, E. A. Hall; works manager, Fred B. Chappell. Their product consists of the Tromblee & Paul rotary sulphur burner, Moore rotary screen, A. D. Wood pulp washers, slushers, water filters and save-alls, Standard wet machines, Standard ground wood wet machines, wood pulp grinders, rotary pumps, etc. In addition to the works at Glens Falls the consolidation gives the organization a large modern plant in Rutland employing from 250 to 300 men, and increases the producing capacity about three times.

**CLEANING INDIA INK FROM TRACING CLOTH.**—An article manufactured by E. H. Anderson at 272 East 199th Street, New York, under the name of "Rasindia" is claimed to completely clean India ink from tracing cloth, without injuring the cloth.

**C. W. LEAVITT & CO.,** 30 Church Street, New York, as buying agents for foreign clients, are interested in receiving catalogs and quotations for export, on oil- and tar-heated furnaces for tempering and anneal-

ing steel. Also covering furnaces for hardening tool or high-speed steel, and pyrometers and other apparatus useful in the production of high-grade steel.

**CORRECTION ON GENERAL BAKELITE CO.**—In our last issue (Aug. 1), page 150, under Perth Amboy, N. J., it was stated in a notice of an addition to its plant that the General Bakelite Co. was a subsidiary of the Roessler & Hasselacher Chemical Co. This statement is incorrect as the General Bakelite Co. is an entirely separate company and not controlled by any other company. The general offices are at 2 Rector St., New York City.

**HUMIDITY AND DEW POINT PATENT.**—The Buffalo Forge Company, Buffalo, N. Y., has issued a statement that the United States District Court has recently sustained the Carrier patent on its dew point and humidity control.

"Suit was brought against the City of Buffalo and Thomas & Smith, Inc., contractors on two installations which the Buffalo Forge Company claimed to be infringements on the Carrier patent.

"The claims cover the automatic regulation of humidity, so as to maintain a constant dew point or saturated temperature by means of bringing air into intimate contact with water heated above the temperature of the water to accomplish the desired result, i. e., the water temperature is variable so as to produce a constant saturated temperature of the outgoing air.

"The court holds that it is not essential that this water should be sprayed into the air, since the defendant's infringements consisted of a tank of hot water which, overflowing, mingled with the unheated water from the spray nozzles, thereby producing the intimate mixture which our patent covers.

"The Buffalo Forge Company consider that heated spray water at a variable temperature, which is controlled by thermostat at the bottom of the eliminator, is an infringement, but a thermostat submerged in the middle of a tank does not infringe, as this would tend to keep a constant temperature of the spray water at a variable temperature with a constant water temperature the air temperature would vary from time to time—and humidity control could only be obtained with an additional thermostat.

**INDUSTRIAL ALCOHOL DIVIDENDS.** Directors of the United States Industrial Alcohol Company at their meeting Aug. 2, declared a cash dividend of 16 per cent on the common stock for the year 1916, a dividend of 10 per cent for the current year, and indicated that hereafter annual dividends of 16 per cent would be distributed.

The first 16 per cent dividend is payable out of surplus accumulated prior to Dec. 31, 1916, and will be paid on Oct. 1 to stockholders of record on Aug. 20, while the second disbursement of 16 per cent, which is for the year 1917, is payable Dec. 1 to stockholders of record on Oct. 20.

The operating income of the United States Industrial Alcohol Company in 1916 amounted to \$6,727,043. The net income was \$4,884,587, and after payment of 7 per cent dividends on the preferred stock, which has ruled since 1907, the year following the company's organization, the surplus remaining for dividends on the common was \$4,336,025. This amounted to 36.14 per cent on the \$12,000,000 of common stock.

In the last seven years the company has earned an average of 9.39 per cent on its common stock, but in recent years the profits have been far above the average. The figure 36.14 per cent for 1916 compares with 12.6 in 1915, and 1.94 in 1914. The expansion in the company's business has been due to the war, with its demand for high explosives, in the manufacture of which alcohol is essential.

"The company's building and development program has now been practically completed," stated Horatio S. Rubens, chairman of the Board of Directors, in announcing the dividend. "The floating indebtedness of the company has been extinguished and the output for the current year has been satisfactorily and firmly sold. The company has set aside out of earnings for the first half of 1917 the sum of \$1,500,000 as a reserve to cover Federal corporation taxes. It was decided to declare a dividend at a rate which, it now seems reasonable to expect, can be maintained under after-war conditions, owing to the entry of the company and its various subsidiaries into additional fields of production, which promise to be profitable under peace conditions."

The company erected the largest distillery in the world at Baltimore last year, in order to take advantage of the war business, and also, at the same time, embarked on the manufacture of acetone, which is used in the manufacture of munitions of various descriptions.

The company was able, it is understood, to obtain European contracts for its enlarged output on highly favorable terms, and since the entry of the United States into the war it has been gossip that its orders from the United States Government have been enormous.

**AMERICAN BRASS ENTERS BUFFALO.**—The Buffalo Copper & Brass Rolling Mill has been sold to the American Brass Company. The plant was taken over by the new owners on July 1 and increased operations will be started as soon as possible.

Announcement of the transaction was made a short time ago by William A. Morgan, president of the Buffalo company. The purchase price was not made public. Charles F. Brooker, president, represented the American Brass Company.

As Mr. Brooker is chairman of the brass committee of the National Defense Board, it is expected the plant will have much to do with the manufacture of brass products for the Government.

The Buffalo plant is the latest addition to the series owned and controlled by the American Brass Company. The concern operates three plants in Waterbury, Conn., two plants in Ansonia, Conn., one in Torrington, Conn., and one in Kenosha, Wis.

It is said special inducements were made by the city of Cleveland to have the brass corporation settle there, but Mr. Morgan drew the officers' attention to this city.

The advent of the American Brass Company into the industrial field of Buffalo is looked upon with favor by local manufacturers. It insures the permanency of the industry which Mr. Morgan has built in three years from a small foundry to an industry which now employs more than 5,000 men.

This Buffalo company has been engaged in the manufacture of brass products for foreign governments for almost three years. When the foreign business began to drop Mr. Morgan thought it best to transfer his plant to an organization which is especially trained for home business.

**TO OPEN WASHINGTON OFFICE.**—The Jones & Laughlin Steel Co., Pittsburgh, has opened a district sales office in the Woodward Building, Washington, D. C., in charge of H. F. Holloway, who is district sales manager of the New York office of the company, and who will also hold the same title in the new Washington office. Mr. Holloway will be assisted by Ralph T. Rowles, who was formerly connected with the Philadelphia office, and covered the Washington, D. C. field. Mr. Rowles will now have his headquarters in the Washington office.

**BON AIR COAL & IRON CHANGES HANDS.**—The Bon Air Coal & Iron Corporation will be organized with a capital of \$10,000,000 to take over the Bon Air Coal & Iron Co.'s properties at Allen's Creek, Eastland, Bon Air and Ravenscroft, Tenn., which have been in receivers' hands for seven years. The new company plans to improve the two stacks and six Gordon hot-blast stoves which the old company operated at Allen's Creek and will add two more stoves, increasing the output to 200 tons a day. At Eastland the company had 200 beehive ovens which produced 80,000 tons of coke a year. The coal mines of the corporation are located at Bon Air, Ravenscroft and Eastland, and it is the purpose of the new owners to increase the output of coal to 10,000 tons a day. Included in the purchase are 27,000 acres of timber land in Wayne County, Tenn., and this property is reported to contain rich ore deposits which will be developed later. The officers of the Bon Air Coal & Iron Corporation are Alex. R. Peacock, New York, president; W. J. Cummins, Nashville, vice-president; A. J. Moreland, Pittsburgh, secretary and general manager; John McE. Bowman, New York, treasurer and chairman. Mr. Peacock was formerly vice-president and sales manager of the Carnegie Steel Co., and Mr. Moreland was formerly connected with the same company. Mr. Bowman is a leading New York hotel man.

**ONTARIO POWER CHANGES HANDS.**—The Provincial Hydro Electric Commission of Ontario has taken over the plant of the Ontario Power Co., at Niagara Falls, Ont. The plant was recently purchased by the Commission at \$22,000,000, of which \$13,000,000 is represented in bonded indebtedness to the company, and it is understood, will form an important link in the Chippawa Creek-Queenston Heights development scheme, the ultimate capacity of which will be 900,000 hp. The Ontario Development Co. has a franchise development of 180,000 hp.

## Manufacturers' Catalogs

**THE R. F. GOODRICH COMPANY.** Akron, Ohio, has issued an attractive booklet on rubber goods for mining, describing a wide variety of rubber products.

**THE ELECTRIC WEIGHING COMPANY.** 180 Thirteenth Avenue, New York, has issued Bulletin No. 10, describing Messiter Conveyor Scales for automatic weighing.

**CHAS. A. SCHIEREN COMPANY.** Cliff and Ferry Streets, New York, has issued a Belt Buyers' Guide containing valuable practical information on the use and care of belts.

**AMERICAN STEEL EXPORT COMPANY.** Woolworth Building, New York, has issued a booklet entitled "Export Engineering and Contracting."

**CHICAGO PNEUMATIC TOOL COMPANY.** Fisher Building, Chicago, has issued Bulletin 137 describing the Chicago Giant rock drill, tapet type.

**SHEPARD ELECTRIC CRANE & HOIST CO.** Montour Falls, N. Y., has issued a comprehensive booklet on hoisting machinery for industrial works.

**TAYLOR INSTRUMENT COMPANIES.** Rochester, N. Y., has issued a booklet on Tyco base metal thermo electric pyrometers.

**FALO COMPANY.** 90 Maiden Lane, New York, has issued a pamphlet describing the Hess-Ives Tint Photometer.

**ROBINS CONVEYING BELT COMPANY.** 13 Park Row, New York, has issued a handbook of conveyor practice giving considerable valuable information.

**PITTSBURGH INSTRUMENT & MACHINE CO.** 101 Water Street, Pittsburgh, Pa., has issued a pamphlet describing the Pittsburgh Metal Sheet Tester.

**FRUEHAUF TRAILER CO.** Detroit, Mich., has issued a booklet on the Fruehauf trailer for carrying up to 10 tons.

**HARDINGE CONICAL MILL CO.** 120 Broadway, New York, has issued catalog No. 7, Section 1, giving general information on Hardinge mills.

**F. J. STOKES MACHINE CO.** Philadelphia, Pa., has issued an attractive catalog on vacuum dryers and chemical apparatus.

## Other New Publications

**COKING OF ILLINOIS COALS.** By F. K. Ovlitz. Co-operative investigation of Bureau of Mines and Illinois State Geological Survey. Issued as Bureau of Mines Bulletin 138.

**ANSWERS TO QUESTIONS ON THE FLOTATION OF ORES.** By Oliver C. Ralston. Bureau of Mines Technical Paper 149.

**BIBLIOGRAPHY OF THE GEOLOGY AND MINING INTERESTS OF THE BLACK HILLS REGION.** By C. C. O'Harra. South Dakota School of Mines Bulletin No. 11. Rapid City, S. D.

**ORIGIN AND OBJECTS OF THE RESEARCH CORPORATION.** Issued by the corporation, 63 Wall Street, New York.

**PLATINUM AND ALLIED METALS IN 1916.** By James M. Hill. Geological Survey Bulletin.

**LITHIUM MINERALS IN 1916.** By Waldemar T. Schaller. Geological Survey Bulletin.

**WHAT SHOULD A PRESENT-DAY METALLURGICAL EDUCATION COMPREISE?** By C. H. Fulton of Case School of Applied Science. Published by School of Mines and Metallurgy, University of Missouri, Rolla, Mo.

**CONGRESS OF HUMAN ENGINEERING.** Oct. 26, 27 and 28, 1916. Published by Ohio State University, Columbus, Ohio.

**PERMISSIBLE EXPLOSIVES.** Tested prior to Jan. 1, 1917. By Spencer P. Howell. Bureau of Mines Technical Paper 169.

**AMERICAN FERTILIZER HANDBOOK.** 1917. Tenth annual edition. Published by Ware Bros. Co., Philadelphia, Pa.

**THE PRIMARY VOLATILE PRODUCTS OF THE CARBONIZATION OF COAL.** By Guy B. Taylor and Horace C. Porter. Bureau of Mines Technical Paper 140.

**ASBESTOS IN 1916.** By J. E. Diller. A Department of the Interior publication, published July 21, 1917.

**TALC AND SOAPSTONE IN 1916.** By J. S. Diller. A Department of the Interior publication, published July 21, 1917.

**PREPARATION OF FERRO-URANIUM.** By H. W. Gilett and E. L. Mack. Technical Paper 177, Mineral Technology 21, issued by the Department of the Interior, Bureau of Mines, Washington, D. C.